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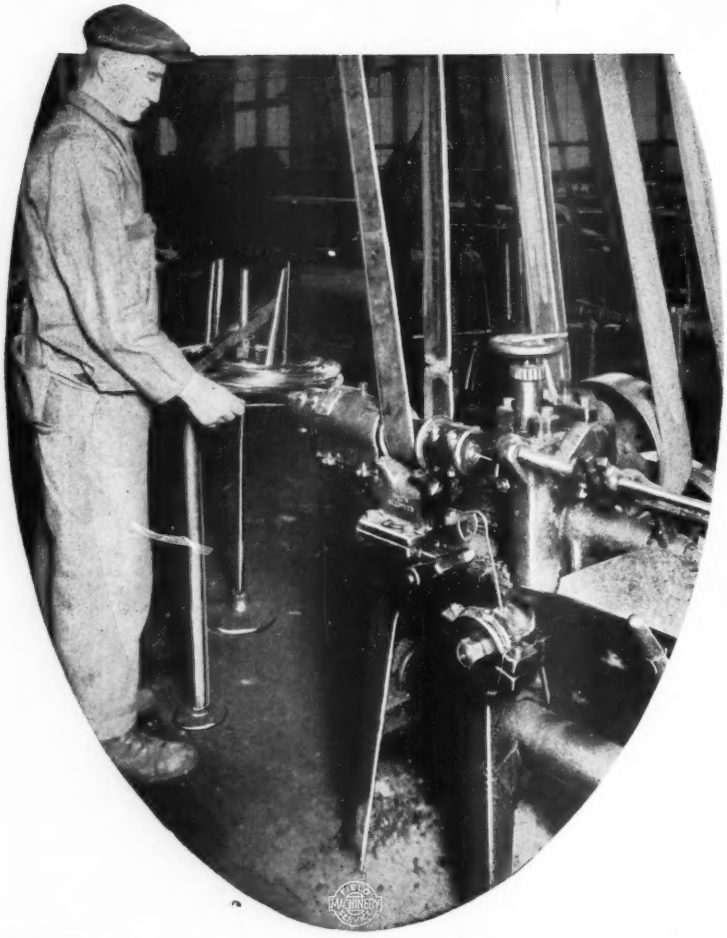
February 1928

Straightening and Cutting Off Brass Wire On a Shuster Machine



IN A LARGE Brass Plant in Connecticut, this Shuster Wire Straightening and cutting machine was installed some 8 or 10 years ago. Brass wire from .040" to .125" is straightened and cut on it, and when photographed it was operating on ⅛" diameter wire cutting to 10 feet lengths.

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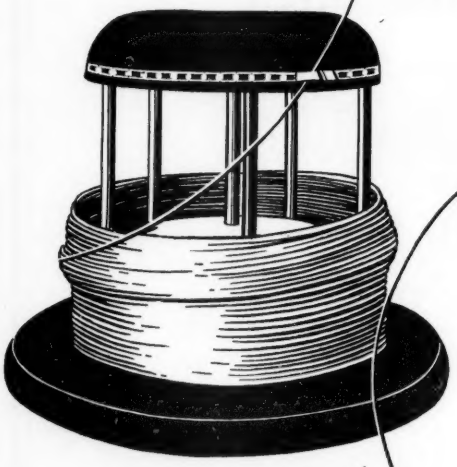

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WIRE & WIRE PRODUCTS

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Vol. 3 February, 1928 No. 2

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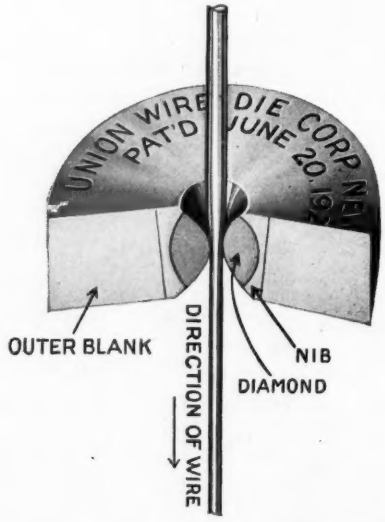

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WIRE
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Vol. 3 FEBRUARY, 1928 No. 2

The Cold Rolling of Steel Wire

Rolling process applied to small gauge wire shows advantages

By Dr. Ing. Hans Goldschmidt

Translated by Paul H. Wueller

THE hot rolling process is commonly used in the manufacture of iron wire down to 5mm dia., while the cold drawing process is used for the thinner grades. The latter process makes it necessary to first remove the

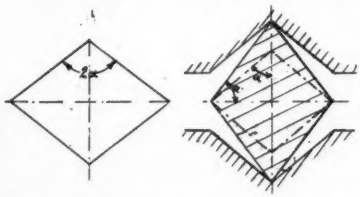


Fig. 1. Cross section of wire as it leaves one roll and enters the next one.

coating of iron oxyd as this film would soon destroy the die. It is for this reason that wire has to be cleaned mechanically and pickled in sulfuric acid. This operation, however, involves many difficulties. The handling of the acids and the piping of the waste waters—the latter sometimes necessitates costly compromises with the neighbours—are the most outstanding ones. Already very early in the history of the industry, attempts were made to confine the preparation of the wire to mechanical cleaning. The patent literature registers a great number of attempts, but experience proved that this process alone does not suffice to prepare the wire properly.

In the following we shall report an experiment in the course of which the cold-drawing process has been replaced by the cold-rolling process, which may be successfully performed after mechanical cleaning. We employed a multi-stage-system, that is to say, the wire had been reduced in four stages on one machine; thicker wire, however, requires single draft machinery. Our experiments rendered satisfactory results, although, they should not yet be considered as closed. Besides, an accurate estimate of the production cost has not yet been possible as certain difficulties pertaining to the material have not yet been overcome.

The first problem arises when choosing the right calibre. Among the many possible profiles, we chose the rhombus with a vertex angle of 100°. This profile permits—by virtue of the successive rolling of "hight on width—of a constant wedge angle (100°) for all rolls, a fact which affords many conveniences in the manufacture and stocking of the rolls. Besides, this cross-section offers another advantage as the edgewise introduced wire does not need any lead. The wire introduces itself automatically in the slot of the roll and shows a tendency to always return to its perpendicular position regardless of twist, when slantwise introduced. This principle of "automatic lead" proved very advantageous in all our experiments.

Fig. 1 shows such a rhombus cross-section as it leaves the rolls. Fib. 1b shows the profile as it enters the roll where it is reduced—see dotted line—upon the indicated cross section.

If angle is retained for all cross-sections, one may employ a single diagram for the plotting of all the cross-sections, in which we enter only one-fourth of the first cross-section. This can

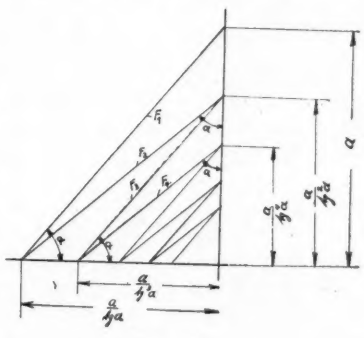


Fig. 2. Diagram showing successive areas of rolled wire.

easily be done by repeated laying off of the angle (Fig. 2). If we assign the letter "a" to the large semi-diagonal of the first draft, then the angle furnishes

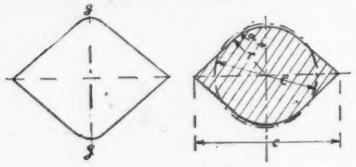


Fig. 3. Stages in change of cross section from rhombus to circle.

us with the values for all the successive semi-diagonals of the series:
(a/tan alpha), (a/tan^2 alpha). (a/tan^3 alpha), etc.

The areas F_1 & F_2 etc. of the triangles are as follows:
$F_1=(a^2/2 \tan \text{alpha})$, $F_2=(a^2/2 \tan^3 \text{alpha})$, $F_3=(a_2/2 \tan^5 \text{alpha})$ etc.

Hence, it follows:
the total area of the wire at draft "n" equals:
$Fn=(2a^2/\tan^{2n-1} \text{alpha})$. Equation 1.

Hence, the areas of the cross-section form a geometric series whose quotient is tan^2 alpha.

The diagram, as well as the computed value of the quotient, indicate that there is no decrease in cross-section when angle alpha=45°, but that it increases with increasing angle. On account of the twisting danger, and because of increased hardening as a result of cold working, reduction cannot be made too heavy; it is advisable to choose an angle of 50°.

The above mentioned quotient tan^2 alpha, or its reciprocal, is identical with the reduction factor in two successive drafts:

alpha	45°	48°	50°
1/tan^{2}alpha	1	0.805	0.703

The number of successive drafts necessary for a specified cross-section Fn may be derived from the equation:

$$N = \tfrac{1}{2}\left\{\frac{\log 2a^2/Fn}{\log \tan \text{alpha}} - 1\right\}$$

Equation 2.

In the diagram Fig. 2 and in equation 1 we did not yet consider a certain widening of the cross-section which is unavoidable. We have to choose the cross-section reduction relatively large, so as to make sure that the wire will exactly fill the new profile. If one does not consider the occurring widening in the new profile, it often happens that the wire is squeezed out of the profile.

In this manner, we determined the drafts for our rolling experiment; from 5.5mm dia. to 1.0 mm dia. in 12 stages.

TABLE 2

Draft	0	1	2	3	4	5	6	7	8	9	10	11	12
2b*	5.5	4.75	4.3	3.8	3.4	3.0	2.7	2.4	2.2	2.0	1.75	1.55	1.35
2a*	5.5	6	5.2	4.6	4.1	3.65	3.25	2.9	2.6	2.4	2.1	1.85	1.62

The experiment showed, that already after five passes, the hardening had reached such a degree that the wire cracked in the further process of working. Hence, we computed a new series of passes; from 5.5mm dia. to 1.0 mm dia. in 16 stages.

TABLE 3

Draft	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2b*	5.5	5.0	4.5	4.15	3.75	3.4	3.0	2.7	2.5	2.2	2.0	1.8	1.6	1.5	1.3	1.2	1.1
2a*	5.5	6.5	6.0	5.4	4.9	4.8	4.0	3.7	3.35	3.0	2.75	2.5	2.3	2.1	1.9	1.7	1.55

*2a is the larger diagonal of the rhombus section of the wire; 2b is the smaller diagonal in millimetres.

This enabled us to draw wire of 1.5mm dia. of faultless quality.

The transfer from the rhombus-profile to the round cross-section of the finished wire has to be facilitated by an intermediate profile. If one were to transform the wire (Fig. 3a) directly into the round wire (Fig. 3b), the drastic cross-section reduction would result in grooves at "g", and in the case of slight reduction, the wire would form an edge and not fill the new profile. It is for this reason that one uses an intermediate profile (Fig. 3b) whose large diagonal is c. Its corners ought to be well rounded out in the spots which correspond to "g" in Fig. 3a. This cross-section, whose area is:

$$F = c\,r \sin \text{alpha} + \frac{90-\text{alpha}}{90}\pi r^2$$

is rolled perpendicularly upon the circular profile in the following stage.

In the following we shall briefly sketch our apparatus, which is shown in Fig. 4.—The process must be considered as an intermediate between rolling and drawing. The wire is led from

TRANSVERSE SECTION

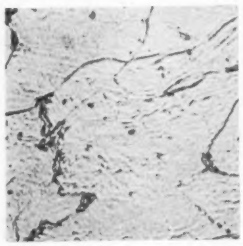


Fig. 5. Wire upon delivery.

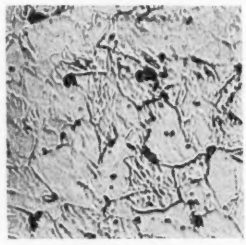


Fig. 6. After third pass.

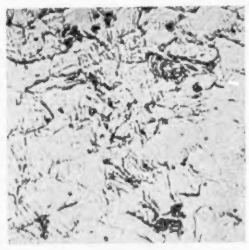


Fig. 7. Fourth stage.

LONGITUDINAL SECTION

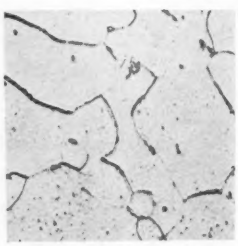


Fig. 8. After first pass.

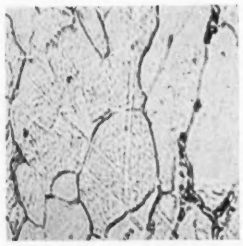
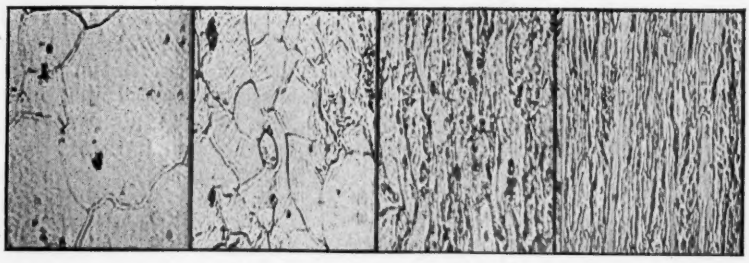


Fig. 9. After third pass.

Fig. 10. Fourth stage.



LONGITUDINAL SECTION

Fig. 11 & 12. After third pass. Fig. 13 & 14. After fourth pass. Fig. 15 & 16. After eighth pass. Fig. 17 & 18. After tenth pass.

TRANSVERSE SECTION

a reel (5, 6, 7)—around which it is wound three or four times—through a pair of profile-rolls (1, 2, 3). The sliding friction in the drawing plate is thus replaced by the rolling-friction of the rotating rolls. The wear, which in the case of the draw plate is concentrated upon the die, is divided uniformly over the entire surface of the rolls. The machine has four pairs of rolls. One roll out of each pair is propelled by a bevel gear, which in turn may be connected with the power-source by means of a winch handle and a friction clutch. The last roll-apparatus has in place of the reel a disconnectable draw drum, as installed in common draw benches.

The lower roller of each pair is fixed upon the frame, the upper roller rests upon round guide rods. The upper rollers may be adjusted (with respect to the lower rollers) by means of two shafts. The rollers are of case-hardened chrom-nickle-steel; they are mounted on a tapered axle. The axles run upon three rows of roller bearings. In order to adjust the two halves of the profiles properly, the two rolls—by means of a gear—may be moved within the frame.

Concerning the quality of the wire, the following longitudinal—and transverse-sections will give the desired information. We tested two sets of wires:

No. 1. cross-section 5.5mm dia. to 1.0mm dia.; 12 passes.

No. 2. cross-section 5.5mm dia. to 1.0mm dia.; 16 passes.

The samples have been soldered into an iron casing, pickled in 2% HNO, and photographed under three hundred fold magnification.

Series 1 (Fig. 5) shows the wire upon delivery.

The picture shows a well balanced tension-free texture. It is very soft iron, almost exclusively ferrous ferricyanide, very little Perlite and some non-metallic inclusions. After the first stage (Fig. 8) the wire shows already a distinct deformation—a greater deformation than should be expected after the first stage. This picture makes it evident that the cross-section reduction of the first set is too drastic. The pictures of the 2nd stage have been omitted. The third stage (Fig. 6 & 9) shows an increasing stretching of the crystals, and the last, the 4th stage, which could be made with this set (Fig. 7 & 10) results already in abnormally long crystal formations.

Series 2. The first passes of this set are not reproduced, because their differences are very small. Stage 3 (Fig. 11 and 12) shows that the stretching of the crystals did not set in so rapidly. The cross-section shows a few well formed slip line formations. At stage 4 (Fig. 13 and 14) the stretching of the crystals becomes more marked. The pictures of the following passes, again, have been omitted in order to enhance the characteristics of stage 8 and 10 (Fig. 15-18). The unusually stretched crystals of Fig. 17 give a significant picture of the distortion that took place.

In order to get more detailed information concerning hardening as a result of cold working, we made comparative breaking tests with drawn and rolled wire—on an Amsler-Breaking-Test-Apparatus—the results of which are shown in Fig. 27. The tensil strength of the wire ($K=34kg/mm^2$) is increased after a cross-sectional reduction of $p=80\%$ up to $K=64kg/mm^2$ when the wire was drawn, but to $K=91kg/mm^2$ when the wire was "rolled-drawn"; that is to say, it is 43% higher in the case of rolled wire. This increased tensil strength (due to the new roll process) represents a striking illustration of the gain, which this process, if compared with common drawing, has in the tensil strength of the

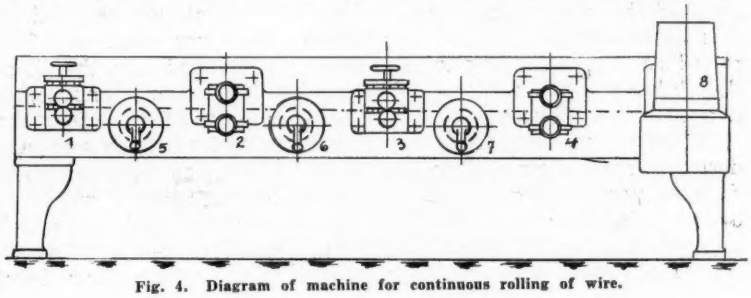


Fig. 4. Diagram of machine for continuous rolling of wire.

substance. These results open a promising future for the process. The possibility of increasing the tensil strength to such an extent may have a bearing upon the export business as it furnishes a means to produce thin wire with relatively high tensil strength. In other cases. again, soft steel will render the same services as carbon-steel, treated under the old process For other substances, e. g. copper, a means is offered to increase the tensil strength in unprecedented manner.

This increase in tensil strength is due to the double strain to which the wire is subject when it is pressed between the rollers while it is at the same time drawn off the drums, as under the simple drawing process.

Our process offers still another advantage as it permits more varied selections of profiles. Of course, a great many profiles may be manufactured under the drawing process, but profile-drawing through non-circular bores is relatively difficult and expensive. The rolling process, however, allows a wide choice of profiles as such a choice does not influence the cost of the rollers. One may, e. g., choose a star-profile for the manufacture of nails. Such nails are far superior to the nails commonly traded. They do not—due to their superior tensil strength—bend under the hammer, the shape of their cross-section facilitates easier penetration, they do not injure the material, and they won't loosen—even if the wood decays.

Appeal Against British Wire Ropeway Dismissed

Proposed wire ropeway to be owned by colliery to ship coal to Dover by seven mile direct route instead of by eleven mile railroad.

THE British Court of Appeal has dismissed the appeals of the Southern Railway Company and of the East Kent Light Railway Company from an order of the Railway and Canal Commission sanctioning, under the Mines (Working Facilities and Support) Act, 1923, a project to carry an aerial ropeway or railway from the Tilmanstone Colliery, Kent, to Dover Harbor. The appeal was heard by Lord Justices Scrutton, Sargant, and Green. The sanctioning of the scheme by the Railway and Canal Commission was reported in WIRE & WIRE PRODUCTS for November last.

Lord Justice Scrutton, in delivering the appeal judgement, said an important question was raised as to the jurisdiction of the Tribunal. Tilmanstone Collieries, Ltd., are lessees of coal at Tilmanstone, Kent. If they desire to send their coal to the nearest port, Dover, it passes over a railway route of 11 miles, partly belonging to the Southern Railway. They desire to ship the coal to Dover by ropeway, the length of which would be seven miles. The cost of doing so would be 1s. (25 cents) less than by railway, without allowing for the extra convenience of having control of their own route. Most of the proprietors on the proposed route of the wire ropeway assented to its construction, but some landowners, among them the Southern Railway, dissented (whose interest in land was confined to the fact that the ropeway crossed at one point a branch of their railway). The colliery therefore applied to the Commissioners under the Act of 1923 for the grant of an ancillary right of conveyance by ropeway of coal from the colliery shaft to Dover Harbor. The Railway objected that the Commission had no jurisdiction under the Act of 1923 to make an order and grant an ancillary right, which was directed rather to marketing than "working" the Tilmanstone coal, and which was sought to be justified on commercial, rather than legal or physical difficulties hampering the colliery. The Commission overruled the objection and granted the ancillary right asked for "to erect, lay down, maintain and use an aerial ropeway" according to certain plans which involved crossing the line of the railway. The railway appealed on the ground that the Commission had no jurisdiction to make such an order.

The power to grant ancillary rights is conferred by section 3 of the Act of 1923. The combined effect of that section and section 1 (2) of the Act is to define ancillary rights as a facility, right or privilege which is required in order that minerals may be properly worked, carried away, treated and converted where the proper and efficient working, carrying away, treating or converting of the minerals is hampered by the failure of the person working the mineral to obtain such right, facility or privilege.

Lord Scrutton said Parliament evidently intended that minerals should be available for national purposes, and where they were unavailable, owing to the unreasonable objection of some person who had the right to object to their proper and efficient carriage way, the Commission might overrule that objection by granting an ancillary right of wayleave or conveyance or making and using railways.

The railway's objection was based on a technical use of the term "carry away." "Work," it said, in mining leases means detaching or severing coal from the coal face; "carrying away" is converting that coal into the lessees' possession. As soon as the coal is "carried away" in that technical sense, the power of the Commission ceases. Before the commission the railway argued it could not extend beyond the land of the lessor. Before the Appeal Court it argued that the limit was not geographical, but one of the purpose of the Act. If the carrying was to the first place where the lessee had effective control it was "carrying away"; further trans-

(*Please turn to page 62*)

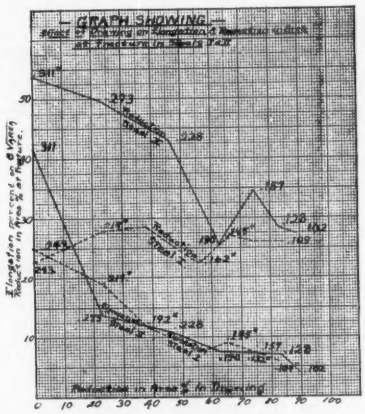
Effect of Drawing and Blueing on the Physical Properties of Wire

By J. D. Brunton

Brunton's Research Laboratories, Musselburgh, Scotland

THE modifications in the physical properties due to wiredrawing depend chiefly on the structure of the steel before drawing and on the amount of cold work put on it. There are, of course, other minor factors, such as the mass or size of the material being drawn and the amount of reduction of each stage in drawing to which reference will be made later. It has been shown above that the structure of the wire before drawing depends (1) on the ultimate composition of the steel and (2) on the proximate composition of the steel which in turn depends on heat treatment. Before considering the general effect of wire drawing itself upon the properties it is necessary to understand clearly to what extent these may differ in the material before drawing and this will best be appreciated by comparing the tensile strength of dead mild steel or iron wire in the annealed condition with steel wire containing about 0.90 per cent carbon in the patented condition. The former has a tenacity of from 20 to 25 tons per square inch, while the strength of the latter is 80 to 90 tons per square inch, and between these two extremes we may have annealed or patented rods of any desired initial strength. It is this initial condition which largely determines the grade of wire produced. A wire with a tensile strength of 100 tons per square inch might be drawn from a mild steel rod or from a high carbon steel wire in the patented condition, but although of equal tenacity these wires would be totally different in other respects.

Wiredrawing itself has a very pronounced effect on the physical properties. The steel is hardened and the tensile strength is increased, sometimes to the extent of 200 per cent and over. The yield point is also increased, but neither this point nor the elastic limit is very definite in hard drawn wire and it is becoming customary to substitute for these terms a load at which a certain definite extension is reached, called the "proof load" or "effective strength", in dealing with cold drawn wire. On the other hand, wiredrawing involves a reduction in ductility which is measured by the elongation; but, although the elongation on a hard drawn wire is very low, the wire is not necessarily brittle, as torsion and bend tests indicate.



Effect of drawing on elongation and reduction.

The chief alterations in the physical properties of the steel involved in wire manufacture are the increase in tensile strength and the corresponding reduction in ductility as measured by the elongation. In measuring the elongation, however, there is one very important point to be considered, viz. the gauge length over which it is measured, as it is obviously incorrect to test the various diameters of wire on the same length of testpiece. The standard gauge length adopted by the British E. S. A. for wire is 4VArea or diameter x3.54. For very fine wire, however, this gauge length would be so small that it would be impossible to measure the elongation accurately and it is sometimes necessary to use a gauge length twice that of the B. E. S. A. standard, that is 8VArea. It is, moreover, largely due to this difficulty in testing the elongation of fine wires that other ductility tests for wire are more commonly employed. These include bend and torsion tests, both alternating and direct, and their main object is to ensure that tenacity has not been secured at the expense of serious loss in ductility or, in other words, that the wire is not overdrawn and therefore brittle.

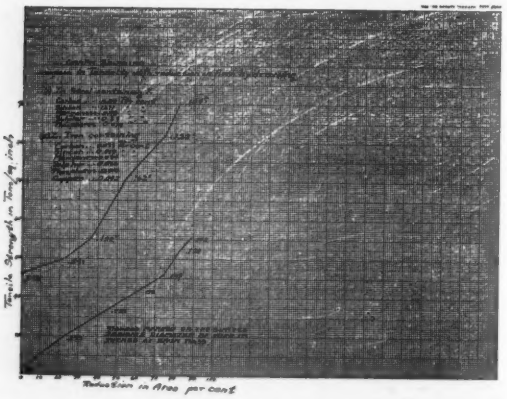
Among the many minor factors influencing the physical properties of wire are the diameter and the percentage reduction at each draught. Thick bars cannot be so severely cold worked as thin rods because the flow is not so uniform throughout the cross-section and also because more power is required to draw them.

It is also a well known fact that a variation in tensile strength and also in other properties can be obtained by varying the reduction at each draught. The heavier the draughts the more rapidly does the tenacity increase.

From these and other factors it will be seen that there is considerable latitude as in the choice of methods in manufacturing wire with apparently similar properties. There are, however, other properties to be

taken into consideration, such as elasticity, resilience, resistance to fatigue, corrosion and abrasion, all of which depend to some extent on the manner in which a wire is manufactured and only experience, assisted by scientific research, enables one to produce wire to suit each particular purpose. Some typical examples of wire for different purposes along with their composition and properties are given in the following chapter.

Other physical properties which are seriously affected by wiredrawing are the electrical, magnetic and acoustic properties; but, since a consideration of these belongs rather to the science of natural philosophy, they need not be discussed here.



Decrease in tenacity with reduction in area by drawing

Figures on curves indicate diameter of wire in inches at each pass.

It is by no means an easy matter to sum up the characteristics of wire from the mechanical or physical point of view or to state the significance of the tests usually applied to it. Wire possesses distinct peculiarities which differentiate it from other structural material. This is due to the introduction of another factor, viz. cold working, which affects the properties to an extent at least equal to that of composition and heat treatment. Take for example the property of hardness, this is modified by composition and heat treatment in a manner which is quite in conformity with the alteration in other properties, but cold working does not increase the intrinsic hardness of a metal in proportion to the increase in tenacity. It is true that the Brinell hardness is on the whole consistent with tensile strength even after severe cold working, although under certain circumstances it is not so, but the true hardness of the metal as determined by instruments which test only a minute portion of the surface is scarcely affected by cold working at all. The exceptionally high tenacity attained in hard drawn wire is analogous to the strength of a lattice structure. This analogy may of course also apply to the general structure of all metals but the bracing of the whole mass by cold working is probably of a much more open nature than say the bracing effect of heat treatment on an alloy steel. The consequence is that the bulk of the metal remains in a soft condition but is held rigid by the broad stiffening effect of cold working, thus we have great tensile strength without brittleness.

		Fatigue limit expressed as percentage of Max. Stress	
		Annealed or Heat-treated	Cold Drawn
I.	Ingot Iron.	48	35 to 45
II.	0.50 per cent Carbon Steel.	45	25 to 35
III.	0.80 per cent Carbon Steel	45	25 to 35

And it may be taken that in general the more severely cold worked a wire is the lower is the ratio of fatigue limit to maximum stress.

At the same time, cold drawn wire is not perfectly elastic, because the whole material is in a state of internal stress, particularly tensile stress, and the individual crystals which are most highly stressed commence to yield at very low loads, so that in a stress-strain diagram the curve is never a perfectly straight line. The departure from perfect proportionality of stress and strain is, however, so extremely slight, even at loads in the neighborhood of two thirds the ultimate breaking load that for most practical purposes wire may be assumed to be elastic up to this point. The elasticity can be increased considerably in wire by "blueing", that is heating to temperatures below 400° C. and this treatment is recommended for springs which have been made directly from high tensile wire. Even after this treatment, however, hard drawn wire is not so perfectly elastic as hardened and tempered steel. The great advantage of high tensile wire for springs and other purposes is its freedom from brittleness. Hardened and tempered steel wire with a tenacity of 100/120 tons per square inch, for example, would be quite unsuitable for ropes or even the strings of pianos because it would be too brittle.

Another property of great significance is the power of endurance under alternating stresses. Considerable research is necessary before this can be definitely co-related with the ordinary physical properties but, so far as the matter has been investigated to date, it would appear that in mild steels the fatigue limit is raised by cold working although not in the same proportion as the tenacity. In patented steel wire it is raised only very slightly, the extent of this increase being indicated approximately by the following examples.

There is one point with regard to the fatigue of high tensile wire which is of considerable practical importance particularly in wire ropes, viz. the rate of break down under stresses above the fatigue limit. It has been found that the endurance of cold drawn wire above the fatigue limit is much greater than that of other high tensile steels, so under conditions, where the life of the material is limited by other factors, such as wear or corrosion, the actual fatigue lim-

it may be safely surpassed at intervals without danger. There is no doubt that this often happens in wire ropes and probably must happen under certain conditions.

Blueing raises the actual fatigue limit of wire very slightly but also increases the rate of breaking down. In short it makes the wire more brittle, as is indicated by torsion and reverse bend tests. Some figures showing how the torsions and bends are affected by blueing are tabulated below.

Effect of Blueing on Bends and Torsions.

Diameter in inches	Bending Radius	Bends		Torsions on 100 Diameters	
		As Drawn	Blued	As Drawn	Blued
0.180	0.55 ins.	11	3	..	..
0.152	5 m-m	4	2	40	23
0.127	5 m-m	4	2	40	11
0.092	5 m-m	9	5	40	15
0.076	5 m-m	12	3	31	14
0.107	0.321 ins.	11	6	24	14

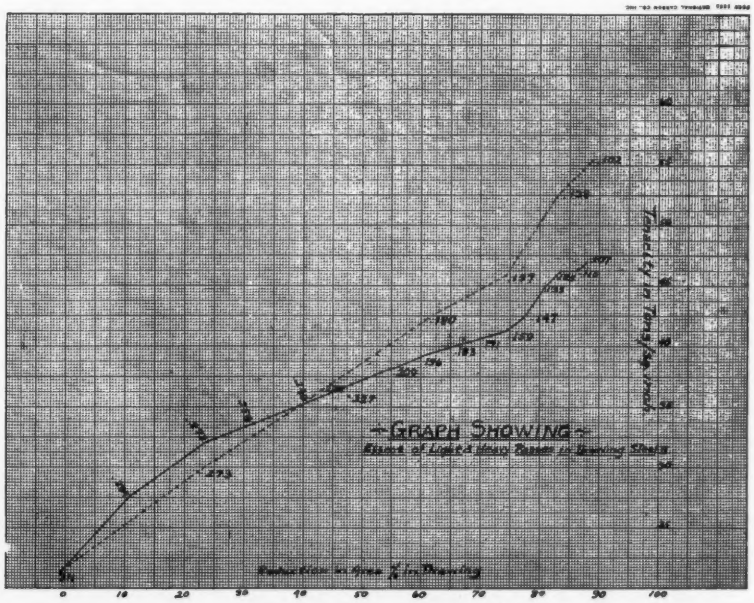
The question of "blueing" or heating to low temperatures after cold work is of considerable practical importance in relation to galvanizing and this work would be incomplete without some reference to this important process.

A large proportion of the wire that is used is galvanised, and this seems to be the most suitable rust proof covering for wire. In galvanised wire there is formed a couple in which the zinc of the galvanised iron forms the electro positive element, and the iron or steel the electro negative, when the material is immersed in impure water or other fluids, which form an electrolyte. The zinc takes up oxygen, gradually forming hydrogen, the iron remains inert even if the continuity of the zinc coating is slightly broken.

In the process of hot-galvanising there is no question, however, but that the strength, and particularly the resistance to bending and torsion are considerably affected. Many theories have been advanced as to why the strength of the material is reduced. Poor material is very often given the blame, but tests have shown that even the best of materials suffer loss. It has been suggested that the material has been overdrawn, but photomicrographs do not show signs of the material being overdrawn. It has also been suggested that irregularity in the coating of zinc might affect the torsion, but here again samples of wire with an uneven coating of zinc show practically no deterioration in this regard. Sometimes hot-galvanising emphasises the effect of a fault which would not be noticed in the black wire, and a section of hard galvanised wire, prepared for the microscope and etched with copper-ammonium chloride, will reveal slight segregation in the wire. When the copper deposit is carefully wiped off with cotton wool while under water, the lighter outer zone is distinguished from the darker inner zone showing segregation. Further etching with an alcoholic solution of picric acid reveals that where segregation has taken place the crystals are larger. This segregation takes place in the centre of the wire, and is one of the causes for wire not giving a good torsion after galvanising.

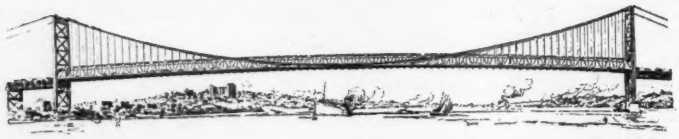
The material has to be pickled before being galvanised, and it has been thought that the brittleness of galvanised steel might be due to the absorbed hydrogen from the acid bath. There is no doubt that this gas can do considerable damage. If, after pickling, however, the wire is heated up to 150° C. for a few hours, any embrittling effect due to occluded hydrogen is removed, and it might reasonably be supposed that the brittleness of galvanised wire cannot therefore be due to hydrogen which will be eliminated at the temperature of the galvanising bath. There is no doubt that between the zinc and the iron there is a layer of an iron-zinc alloy, formed either because the wire was left in the bath too long in contact with the zinc, or because the zinc was too high in temperature. That such an alloy does exist is well known, as every galvaniser has to contend

(*Please turn to page 66*)



Effect of light and heavy passes in drawing Steel II.

Two Suspension Bridges to be Built



LARGELY because of the remarkable performance of the Philadelphia-Camden Bridge, which far exceeded the most sanguine expectations and increased land and property values sufficiently to more than pay the cost of the structure, sentiment in favor of bridges has been rapidly crystallizing throughout the country. Indicative of this trend are the two contracts recently awarded for suspension bridges—one over the International boundary line between Detroit and Windsor, Canada; the other over Mount Hope Bay at Bristol, R. I.

According to the American Cable Company, which organization was awarded the contracts for the wire entering into the cables and suspender ropes, the total length of the Detroit International Bridge, with approaches, will be approximately 1.7 miles; the main suspended span 1,850 feet. This bridge will have a main span of 100 feet longer than the Delaware River Bridge at Philadelphia, at present the longest suspension bridge in the world. The Detroit International Bridge will offer the shortest route from points north of Fort Wayne, Indiana, to points in New England and Eastern Canada, via Niagara or Toronto over the new Kings Highway, and will be completed in August, 1930.

The suspension bridge spanning the Mount Hope Bay at Bristol, Rhode Island will have a capacity of 3,000 cars an hour and will provide a direct highway route of 28½ miles from Newport to Providence, thus effecting a saving of nearly 9 miles over the present route. The main suspended span of the Mount Hope Bridge will be 1,200 feet in length.

Bridges of the cable suspension type were chosen as being the most practicable and economical, due to the new type of wire produced at the plants of the Page Steel & Wire Company, another associate company of the American Chain Company. The wire, drawn by a new process is said to afford increased working stress of more than 20 per cent without additional weight or volume of metal.

Standard for Chain Link Fence and Fabric Adopted

A GENERAL conference on Chain Link Fence and Chain Link Fabric held in Cleveland, Ohio, January 10th, 1928, adopted a Commercial Standard for this commodity, according to an announcement of the Assistant Director in charge of Commercial Standards Group of the Bureau of Standards.

Prior to the adoption of this Commercial Standard, which includes simplification of sizes and dimensions, the fence was produced in the fellowing heights: 3½′, 4′, 4½′, 5′, 5½′, 6′, 6½′, 7′, 7½′, 8′, 9′, 10′, 11′ and 12′. The standard heights adopted are now; 5′, 6′, 7′, 8′, 9′ and 10′. Gauges 6, 7, 8, 9, 9½, 10, 11, 12 and 14 were formerly used but have been reduced to 6, 9, and 11.

Meshes were formerly in the following sizes; 1½″, 1¾″, 2″, 2¼″, 2½″. They are simplified to 1¾″ and 2″. The approximate percentages of reduction in heights, gauges, and meshes, are as follows; Heights, 57 per cent; Gauges 66 per cent; and meshes 60 per cent.

The conference appointed the following membership on the Standing Committee to serve as a liaison between the Department of Commerce and industry; J. H. Kinney of the Cyclone Fence Company, Waukegan, Ill., W. T. Kyle, of the Page Steel and Wire Co., Bridgeport, Conn., and H. G. Thomson of the Anchor Post Fence Co., Baltimore, Md., to represent manufacturers; T. C. Potts of the Horace T. Potts Co., Philadelphia, W. J. Thwing of the Security Fence Co., Summerville, Mass., and A. R. Dinn of the P. H. Dinn and Co. of Boston, to represent the distributors; and National Electric Light Association, The American Railway Association, and the Bureau of Yards and Docks, Navy Department, to represent the organized consumers.

This recommendation is to become effective January 15th, 1928, and remain in effect for a period of one year, subject to regular annual revision by a similar conference or the standing committee thereof, according to the announcement of the Commercial Standards Group of the Bureau of Standards.

Institute Of Metals

DURING the past year the membership of the Institute of Metals increased from 1801 to 1903. It is anticipated by the Council that the present year—the twentieth of the Institute's existence—will witness the enrollment of the 2,000th. member. An election of members is due to take place on Wednesday next, January 18. Particulars of membership are contained in a booklet descriptive of the work of the Institute which can be obtained from Mr. G. Shaw Scott, M. Sc., Secretary, 36 Victoria Street, London, S. W. I. The annual general meeting of the Institute will be held in London on March 7-8, and the autumn meeting in Liverpool on September 4-7.

Electroplating Wire by the Continuous Method

PART II.

By Harrison B. Williams

THE conditions surrounding ordinary tank electroplating are so different from those in the plating of wire continuously that the data in electroplating hand-books is of little use to the wire plater; there being so many things impossible in ordinary plating that may be done with impunity in wire plating.

The reason for these differences should however be carefully noted as slight changes in plating procedure may cause large waste in material if the effect of the change is not considered in the light of the few simple requirements that must be met.

In the first place a metal surface to be successfully electroplated must be clean. It must be free from dust and from invisible films of grease such as would result if the metal surface were touched by the hand. The surface should be free from oxide or other metallic salt films. In ordinary plating these requirements are met by the usual series of caustic and pickle and hot water dips and in no case are these omitted.

In wire plating one pass through a die can often be used as the only preparation of wire for plating as illustrated in the first section of this article where wire is taken from the coil directly to the acid plating tank without any pretreatment. When this is done the wire must either be passed through a die not shown in the cut, placed between the reel and the plating tank or it must be given a pass immediately before starting the plating operation and handled with oil free gloves when changed from the block to the reel.

A far safer method and one which will produce plated wire that will draw without flaking off is the method mentioned in part one of this article where the wire before entering the tank passes first through a hot caustic bath which may be a caustic dip as sold under various trade names or it may be merely a ten per cent. solution of caustic soda. The soda solution should be hot and may be heated by a steam coil immersed in the tank which of course must be of metal, generally iron.

The next tank in the series is one containing water to remove the caustic adhering to the wire. The third tank is filled with any of the usual plater's acid dips for the removal of oxides and scale and is followed by a water dip in the next tank to remove this acid from the wire. This water tank may be omitted without serious difficulty the only function being to prolong the life of the cyanide striking solution in the next tank which is also a standard solution of the plating trade and to be found in any plater's handbook. The striking solution prevents the wire from self plating upon coming into the plating tank, which would happen if it were not immersed in this mercury cyanide striking tank. Following the striking tank there may be a hot water tank or the wire may go directly into the plating tank. In large continuous production the hot tank is advisable as it prolongs the life of the plating solution, by removing all traces of the solutions carried over on the wire surface from the pretreatment tanks, that may otherwise in time interfere with the best operation of the plating solution.

An article on

The Manufacture of Tinsel

By Harrison B. Williams will appear in the next issue of Wire & Wire Products

Wire used in silver plating should enter the plating tank either as hard drawn wire or as half hard wire never as annealed wire the latter occasioning considerable trouble in subsequent drawing.

The method of computing the amperage necessary to give a plate of any given thickness of silver or as is usually the practice in the trade, of any given percentage of silver, is as follows.

One ampere regardless of voltage will deposit exactly 4.025 grams of silver in one hour. This is equal to .00907 pounds. Thus if we are plating .010" diameter wire and have three complete turns of wire back and forth between submerged plating tank rolls eight feet apart there would be about fifty feet of wire submerged in the tank weighing .016 pounds. Thus if we desire a plate of one percent we will require an amperage sufficient to deposit one percent by weight of .016 pounds or .00016 lbs of silver on this fifty feet of wire irrespective of the speed it may pass through the tank. Since one ampere hour deposits .00907 pounds of silver per hour it will deposit .00015 lbs. per minute which is just under the amount we require. Therefore a speed of 47 feet per minute will give the required plating if a current density of one ampere is used.

This current being only about one half the maximum density permissible in a wire of .010

diameter it is possible to speed up the wire to 94 feet per minute, using two amperes of current.

As the size of the wire increases the amperage permissible without danger of annealing the wire increases directly as the square of the diameter of the wire while the surface exposed to plating solution increases only directly with the wire diameter. Thus the current per square inch of wire surface exposed to the plating solution becomes the limiting factor in plating speed in large wire while the amperage that may be carried without annealing the wire limits the speed in plating the fine sizes. The current density permissible without danger of burning as it is called or the deposition of hydrogen instead of silver is very much higher in the plating of wire than in any other plating operation and the current densities given in the handbooks are not applicable to this work. The real limit of current per square inch depends upon the provision for circulation of the plating solution so that the solution in immediate contact with the wire is constantly changed as the silver is deposited out of it and to secure this the various methods of agitation are all good. Compressed air allowed to bubble up through the tank will do the work or stirring paddles may be used or even the mounting of the entire plating tank upon a rocking mechanism with an arrangement of baffle plates to take advantage of the flow set up, is well worth the cost.

When more than one wire is plated at one time in the same tank the amperage permissible on each wire is less than where only one wire is being plated. In the case of one wire only in the tank it is immaterial if due to difference in solution density at different points of the wire the wire is given more silver at certain parts of its travel than at others as the total silver deposited will be uniform in thickness. While in the case of multiple wire plating the presence of areas of plating bath low in silver is absolutely fatal as the current will follow the lines of least resistance and these lines are through the areas of high silver solution. This will result in a difference of as great as one hundred percent in silver between wires having passed through a tank under apparently exactly similar conditions and where each wire may have been tested with an ammeter under operating conditions for the amount of current it is carrying. The reason why a plating set-up, with each wire having the same relation to the anodes as every other wire and where they all travel through the same distance in the bath and where each wire shows the same amperage passing through it when the tank is started, can yield many different weights of silver in the final wire test is not at first glance apparent.

An article on
The Annealing of
Brass Wire
By F. Ostermann
will appear in
an early issue of
Wire & Wire Products

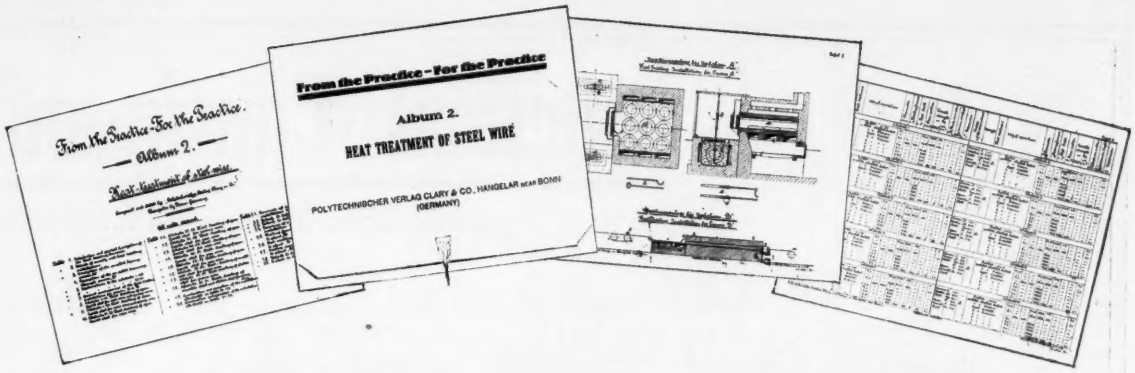
It is only by connecting each wire in the tank to a separate ammeter so arranged that a continuous reading may be had while the tank is in operation, that we are able to trace the source of the variation. When the above set-up is made and the distance from the pretreatment tanks as well as the final washing tank is made sufficient to make the wire resistance enough to prevent the current from shorting through the tanks where a different potential is necessary in each wire to give uniform amperage; it is found in operation, in a still tank or in one not very strongly agitated that the amperage in each wire is subject to very wide and very rapid fluctuations.

The amperage will fluctuate even if each separate wire is put in series with a rheostat so that the potential on any wire running an amperage higher than the rest is cut down or as is more often the case if one wire shows considerably less amperage than the rest the resistance on all the rest is increased to enable the low wire to have its voltage brought to a point where the ion speed will give it amperage equality with the rest. The reason for this condition is the removal of silver from the plating solution faster than ion migration can renew it and owing to unequal agitation in the tank solution some wires are surrounded with denser solution than others. Again where the path of the agitated solution is parallel with the wire the agitation effect is negated.

One of the best remedies for this condition is the avoidance of anodes parallel with the bottom of the tank and consequently parallel with the direction of travel of the wires. With anodes in this position particularly with the anodes between the top and bottom of the submerged rolls midway between the two sets of wires where they might be supposed to operate best there is a strong tendency to form layers in the plating solution. The layer through which the wires travel becomes very poor in silver and the layer in the plane of the anodes becomes high in silver. As these layers under agitation are only partly broken up the most serious consequences arise as above outlined and no amount of current regulation can correct the evil.

When the anodes are suspended vertically this condition is largely eliminated so that the anode arrangement where bus bars are run the length of the tank between the groups of wires being plated and the anodes are suspended from these bus bars is the best arrangement. It is then necessary to use only one ammeter on each bus bar, and to shift anodes until the outside bus bar ammeters show each one half the amperage indicated by the inside bus bars or those

(*Please turn to page 64*)


From the Practice-For the Practice
Album 2.
HEAT TREATMENT OF STEEL WIRE
POLYTECHNISCHER VERLAG CLARY & CO., HANGELAR near BONN (GERMANY)

From The Practice For The Practice

Review of "Heat Treatment of Steel Wire"

By L. D. Granger

Chief Metallurgist Wickwire Spencer Steel Co.

THIS title aptly describes the textural treatment and material in the set of sheets issued by the "Polytechnicher Verlag Clary u. Co." of Hangelar by Bonn, Germany.

The tables or schedules are prefaced by a general consideration of iron and steel in metallurgy, and, after some study and a consideration of the working of the German mind, we gather that high carbon wires must be subjected to a modified hardening process, producing a Sorbitic structure in the material in order to avoid the bad effects of annealing, by which "the increase in strength of the steel obtained by drawing will always be neutralized by compression." It is left largely to the imagination to decide just what this means.

Two methods of heat treating are described, and full constructional details of the furnaces are given. Method A consists of a treatment "en masse", heating the coils of wire in a muffle furnace, and then quenching the whole coil at once in a lead bath properly heated and located. This method is properly recommended only for process treatment when uniformity is not essential.

For final heat treatments the conventional air heating and lead quenching furnaces are described, and it is stated that twelve wires may be treated simultaneously.

The furnace described is an elaborate elongated muffle in which "lighting-gas" is introduced to avoid scaling of the wire. A gas producer is built integral with the furnace, and the method of firing, insertion of emergency grates for cleaning the fires, addition of coal, use of steam jet, etc., are carefully described. Economy of fuel is secured by regenerating the combustion air.

The tables themselves fall short of the usual German wealth of detail, and certain inaccuracies of the text are to be noted. For instance, the statement is made in the first column of Table 4, that "the tensile strength of the heat-treated wire has been 134/ko/mm2 (190590 lbs. per sq. in.) with an extension of 1.5%". Examination of the schedule mentioned (Schedule 1) shows that the item referred to is the wire drawn one draft from 5.4 mm. to 4.6 mm. We feel that an attempt to draw a patented wire any distance with an initial elongation of 1.5% would be productive of disastrous results. This same error is repeated on the same page, column 2, in the description of Schedule 6.

It would help a great deal and furnish the wire mill with very valuable data if the physical properties of the wire patented at the various combinations of temperature should be given.

There is no question but that in the proper hands, a great deal of useful and practical information may be secured from a study of the various schedules. Care must be taken, however, to read the text over fully in connection with the practices given, as many of them are recorded as producing defective wire, the torsions or bends being lower than specified.

However, definite information on how not to do it is oftentimes as valuable as knowing how.

We would suggest that the various schedules might be amplified with the recording of physical properties of the wire at process points, and that they carry a note at the head informing the reader as to whether the wire produced would be of satisfactory quality or not.

The data are, of course, in the metric system, but this does not put an unsurmountable obstacle in the way of the metallurgist. With a thorough reworking of the diameters and tensile strengths, correction of errors in text, rewriting in idiomatic English, and addition of missing data, these tables should prove a ready work of reference for mills drawing high carbon wires.

Sleeper & Hartley TRADE MARK

Practical Continuous We

These Machines Go Into Production a—Rec

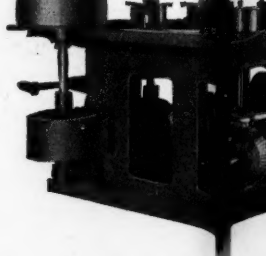
Rod Frame

(No. 5—14 or 15 wire)
Patented June 3, 1924—May 12, 1925—others pending

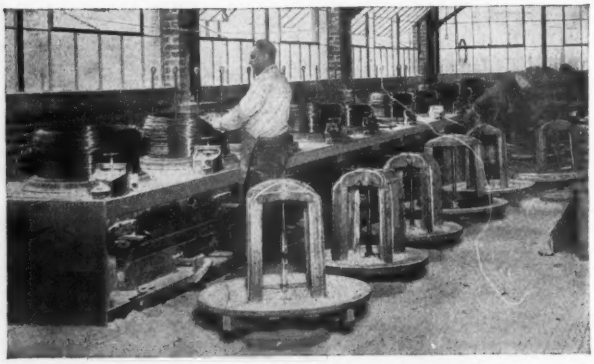
All Ball or Roller Bearings
No Differential Gearing.
Automatic Compensation for Speeds of Heads.

Double 5-Dra, I

No. 14 to No. 23 low
3 to 4 Block age
No. 14 to 19—00 lb
No. 14 to 20—00 lb
More than 250 heads of ved

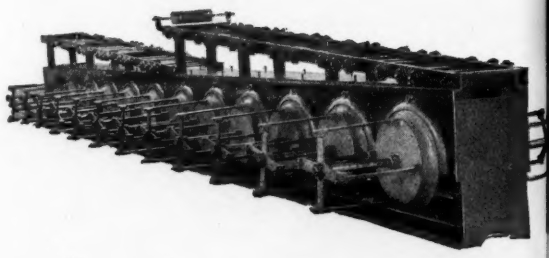


IMPROVED WIRE MILL EQUIPME



Standard Rod Frame—10 Block

Long, Stiff Spindles, in anti-friction bearings, and equipped with friction Clutches. Powerful and reliable.
Practically noiseless in operation.
(New Plant of Thompson Wire Co., Worcester, Mass.)



Patenting Furnace Take-Up

(New Plant of Thompson Wire Co., Worcester, Mass.

Do

Direct
friction
(Ne

AGENTS: CHICAGO TERRITORY,
Neff, Kohlbusch & Bissell, Inc.

SLEEPER &A

FOREIGN AGENTS AND REPRESENTATIVES: UNITED KINGDOM—Mr. Fredk. A. Perry, 63 Queen Victoria St., London, E. C. 4. FRANCE—Mr. Edgar Bloxham, 12 Rue du Delta, Paris. BELGIUM—Isbecque, Todd & Cie., 25-27 Boul. Emile Bockstael, Brussels.

WORCESTER, MA

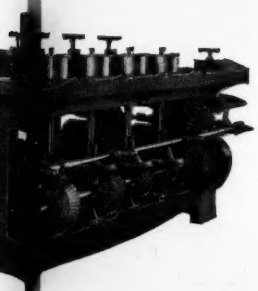
Drawing Machinery

Sleeper & Hartley TRADE MARK

n a—Reducing Overhead-Increasing Production!!

ra , Intermediate

. 23 low carbon wire.
ock age Operator.
—400 lbs. per block.
—500 lbs. per block.
s of ved model in operation

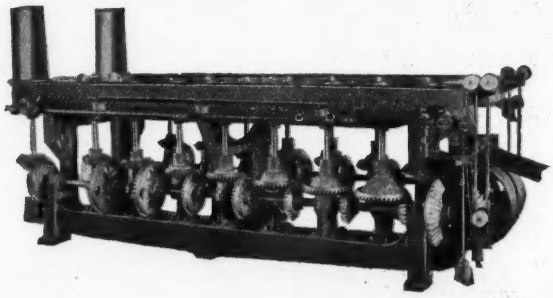


Double 8-Draft Fine Wire: Wet

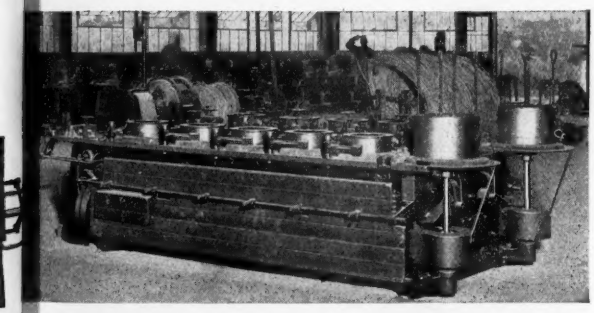
No. 22 to 36. High or low carbon wire.

6 Blocks to Average Operator, 22-33, 8-hole, 660 lbs. per day of ten hours.

Many thousands of these heads in operation

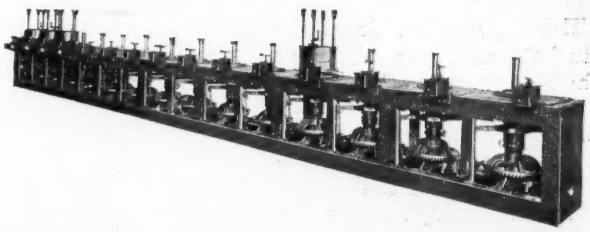


QUIPMENT RECENTLY INSTALLED



Double Six—Draft Dry Continuous For High Carbon Wire

Direct driven with silent chain. Cut gears throughout. Anti-friction bearings. Variable speed for finishing block.
(New Plant of Thompson Wire Co., Worcester, Mass.)



Heavy 16" Frame For .65 Carbon Wire
No. 10½ to .037"

15 Blocks: Motor driven. Silent chain. Anti-friction bearings and cut gears throughout.
(New Plant of Johnson Steel & Wire Co., Worcester, Mass.)

&ARTLEY, Inc.

Agents: Philadelphia Territory
Swind Machinery Co.

ITALY—Henry Coe & Clerici, Milan. AUSTRALIA AND NEW ZEALAND—Edwin Wood Pty., Ltd., Melbourne.
JAPAN—Andrews & George Co., Tokyo. SWEDEN AND FINLAND—Akt., Rylander & Asplunds, Stockholm.

TMASS., U. S. A.

NEWS OF THE INDUSTRY

AMERICAN Telegraph and Telephone Co., is planning a large program of expansion to cost $38,000,000. It is to include aerial wire and pole lines $4,341,000; long distance cable lines, conduits, buildings and equipment, $19,791,000; line work, wire and pole replacements etc. $4,345,000.

E. R. GOLDAPP, for 12 years with the Portland Wire and Iron Works has been made manager of the company. He succeeds T. H. Banfield, who has been appointed manager of the Parker Banfield Co., owner of the Portland Wire and Iron Works.

THE Washburn Wire Co. has commenced extensive additions and improvements to its plant in Phillipsdale, East Providence, which will involve several hundred thousand dollars before completed. A new building is now in process of construction to be used as a rod mill. It is of steel and glass construction, one story in height and 108 by 132 feet, costing about $300,000.

THE Phillips Wire Co., Pawtucket, has been absorbed by the General Cable Co. of New Jersey. The Pawtucket plant is a part of the $5,000,000 merger that was planned some time ago to include several of the largest wire and rod companies in the country. The Pawtucket plant is a part of the Safety Cable Co. which was part of the merger when it was first projected. Officers of the plant are as follows: Walter F. Field, president; William C. Hall, treasurer, and George T. Cottle, vice president and general manager, all of New York.

Wire Works Inc. To Expand Plant

THE Worcester Wire Works Inc., will expand its plant, due to increased business, with a two-story addition 70 feet wide and 210 feet deep. The cost is placed at $30,000. Nils A. Bjork is president of the company.

Automatic Cable Layer Perfected

A NEW machine has recently been adopted by the Weissenfels-Zeitz Electricity Association, a well-known German electric supply company, which promises almost to revolutionize its service. It is the invention of Herr Schramm, manager of the association, and has been built by the Weserhutte A. G., of Oeynhausen I. W., the well-known trench-dredger builders.

Almost all German high-tension lines have been laid out as overhead lines on masts and entail heavy expenditure on upkeep. Consequently there has for some time past been a demand for the substitution of underground cables for such conductor lines. The new cable dredger is designed to reduce the cost of cable laying, particularly that of the earthwork connected with it, which has hitherto been very high. It carries out all operations automatically and is composed of four parts—the trench dredger which digs out the trench 45 cm. wide and up to 1.3 meters deep, the conveyor, which with its rotating terminal chute throws the excavated soil behind the trench dredger back again into the trench, the cable car drawn by the dredger which carries the cable drum and at the same time rolls in and levels the soil (which, of course, having become loosened, lies above the original level), and the feeding mechanism laying the cable into the open portion of the trench behind the dredger.

The two vehicles—the trench dredger and the cable car—are mounted on caterpillar wheels, and will pass over any kind of ground. All machines are driven from the same prime mover—a 45 horse-power Diesel engine. Five men are required to operate the complete outfit, which, according to circumstances and the condition of the soil, will lay in position 93 meters, 80 meters, or 61 meters of cable, thus cutting down the cost of a given length of cable to about one-eighth of that of an equal length of hand-laid cable. When it is considered that an overhead line has a life of only about 15 years, whereas an underground cable will last upwards of 45 years and entail practically no cost of upkeep, the importance of the machine from an engineering and economic viewpoint will be readily gauged.

New President of American Steel & Wire Company

ELECTION of John S. Keefe as president of the American Steel and Wire company to succeed the late William P. Palmer was announced. The company is a subsidiary of the United States Steel corporation. Mr. Keefe has served as chairman of the traffic committee of the United States Steel corporation since 1903.

Frank Baackes was elected senior vice president in charge of commercial matters and H. A. Barren vice president in charge of operations. D. A. Merrian was made manager of sales and C. F. Blackmar general superintendent of wire mills. L. J. Gray was appointed assistant to the president.

British Cable Inquiry Closed

THE hearing of the application of the Cable Makers' Association for an order for marking imported electric cables has now been concluded by the Board of Trade Committee in London. Sir H. Llewellyn Smith presided at the final session.

J. Dow, managing director of the Amorduct Cable Co., London, said his firm imported cables. He had never had a case of a wholesale or electrical contractor being under misapprehension as to whether the

cables he bought were British or foreign.

Dealing with the suggestion of the applicants that the insertion of a marked tape would only involve very small cost, Mr. Dow said that in the case of cotton-covered flexible cable used in ordinary house lighting the increased cost would be 10 per cent. In the case of silk-covered flexible cable it must be remembered that in Britain there is an ad valorem duty of 33⅓ per cent., so that the increased cost would be 15 per cent. Witness said he did not think the various methods of marking suggested by the applicant could be so easily applied as they contended. If there were no manufacturing difficulties, he declared he would have no objection to the maker's name appearing on the cables he sold.

J. Barrett, of Barrett & Wright, electrical contractors, said that his firm sold both British and foreign cables. He said he considered label and price a sufficient indication of origin. He further stated that he had never known a customer complain of being deceived.

Answering R. Moritz, counsel for the applicants, Mr. Barnett said he agreed that apart from label and price it was not possible to distinguish between British and imported cable, but there were some British manufacturers who produced cable comparable in price to Continental cable.

After counsel had addressed the Committee, the inquiry was closed.

Big Electric Cable Orders in Britain

AMONG recent big cable orders placed in Britain is a contract, valued at $2,000,000, for overhead transmission lines in the south of Scotland for the Central Electricity Board. This order, which has been placed with British Insulated Cables, Ltd., Prescot, Lancashire, is only one of numerous similar orders that will have to be placed by the Board as its project for the reorganization of the country's power supply stations progresses.

Although of much smaller dimensions, a recent contract of the Rotherham Borough Council is also of great interest. The contract, which is for cable required by the council's electrical department, has been let to a foreign firm at $23,188. In reply to questions at the council meeting one alderman said it had been the policy of the committee to place tenders in Britain when the price was within 10 per cent of the amount quoted elsewhere, but they could not afford to pay beyond that margin. The successful tenderer is a Dutch firm. A similar decision has been come to by the Doncaster Town Council, which, on the recommendation of its electricity committee, accepted a tender for low-pressure cables manufactured by the Netherlands Cable Works, Delft. The chairman of the committee said they were saving 11.1 per cent on the lowest British tender.

Work on the Scottish electrical unification scheme will start early in 1928, and may be completed about the middle of 1930. There will be about 1,000 miles of aluminum-covered steel conductors, and 29 route miles of double-circuit lines, and 199 route miles of single-circuit used. The working pressure will be 132,000 volts.

Rope Combine Makes Bad Start

IN the annual report, which has just been issued, the directors of British Ropes, Ltd., the big rope-manufacturing combine, state that they consider the 12 months ended August 31 last to be the worst ever so far experienced by the rope industry. The coal strike continued until the end of November, 1926, with the result that the first three months of the company's trading (the combine has only been formed a year) resulted in a definite loss, which had a decided reflection on the whole year's trading. Unfortunately the coal industry did not show and has not yet shown the recovery that was anticipated. These considerations necessitated the deferment of the payment of the Preference dividend which fell due on June 30 last, and this dividend will again be deferred from January 1, 1928.

Considerable progress, the directors state, has been made during the year with the reorganization and consolidation of the businesses of the subsidiary companies, with the result that

(*Please turn to page 63*)

Interior of hangar in Los Angeles showing construction of duraluminum frame for an all metal dirigible bag.

Digest of Current Literature on Wire

How Wire Is Galvanized

Diagram from Electrical West, Aug. 1, 1927.

In the diagram herewith, the bath A is covered by the patent of the Indiana Steel & Wire Co. It contains carburizing material claimed to increase the bond between the wire and its coating. This has always been the defect of wire-galvanizing processes, the bond between wire and zinc being so poor that it would rub, flake or come off under very slight rough handling.

Acceleration Stresses in Wire Hoisting Rope

G. P. Boomsliter, Univ. of Va., in Paper 1641A, Amer. Inst. Min. & Mett. Eng's., abstracted in Mechanical Engineering, April 1927.

In the discussion of stress in wire hoisting cable, consideration is seldom given to the effect of elasticity of the rope itself on the stresses of acceleration. This has become important with the advent of motor-driven hoists, and their much higher speeds. The torque is not constant. Experiments were made including field tests on mine-hoisting cable, using the telemeter. As a result of these, the author asks if the short life is not due to excessive stress, in turn due to neglect of the full effect of acceleration. Mine laws recommend a factor of safety of 5, calculations involving theoretical acceleration stresses cut this to 2; endurance limit is one-half the ultimate. Thus, the greatest stress under normal conditions is just barely below the endurance limit. He gives these values:

Diam. In.	Load Lbs.	Breaking Load from Catalog	Ultimate Strength	Values of the Modulus of Elasticity			
				First Aver.	Down	4th Appl.	7th Appl.
½	17,100	16,800	155,455	10,500,000	18,800,000	15,000,000	17,200,000
1	69,850	60,000	155,500	6,000,000	18,000,000	16,800,000	14,100,000
1¼	109,000	94,000	166,400	7,700,000	16,500,000	15,600,000	17,400,000

There was a pronounced twist after the first application.

Advantages of Lubricating Wire Rope

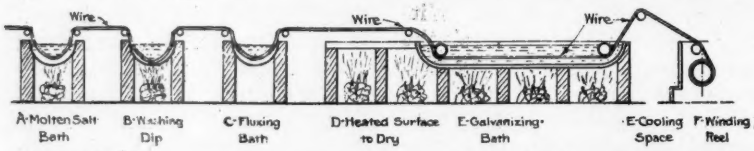
From Cassler's Industrial Management (London), August 1927, pp. 279, etc.

Good wire rope is made with a core impregnated with oil but this gradually oozes out. To prevent the core becoming dry, regular applications of a suitable lubricant are necessary. This retards the corrosion of the wires, deterioration of the core, reduces internal friction and reduces external wear. The heavier the tension, or smaller the sheaves, the more frequently must the wire rope be lubricated. It should be thin enough to penetrate but not so thin as to run off, nor so thick as to cover the strands. It is applied best by running the rope through a tank containing the oil, or if grease is used, through a tank with the grease and having a fire or heat below it. New rope, if dry, should be lubricated before using. The better the wire is lubricated inside and out the longer will be its life and service.

Gas Films in High-tension Cables

Luigi Emanueli, chief engineer, Pirelli Co., Milan, Italy. Electrical World, Sept. 24, 1927.

The author discusses the gas films which are formed by insulating compounds, inside of the lead or other sheath. The effect of these is considerable, changing the power factor and causing a loss of energy. He discusses various oils, compounds, forms of insulation, the production of gas by volume, effects of this, and so on, emphasizing many of the points by charts and tables of data. Microphotographs are given of gas bubbles. The apparatus used is described, also the progress of the tests. In his summary, he says, it is evident that something must be added regarding the quality of the insulating compound. If it is rather viscous, it is difficult to move and a good barrier to gaseous ions. If it is liquid, it is easily pushed away but tends to refill the gas paths. Better results are obtained from fluid oils than from viscous compounds, in both cables and joints.



How States Specify Woven Wire Guard Rail

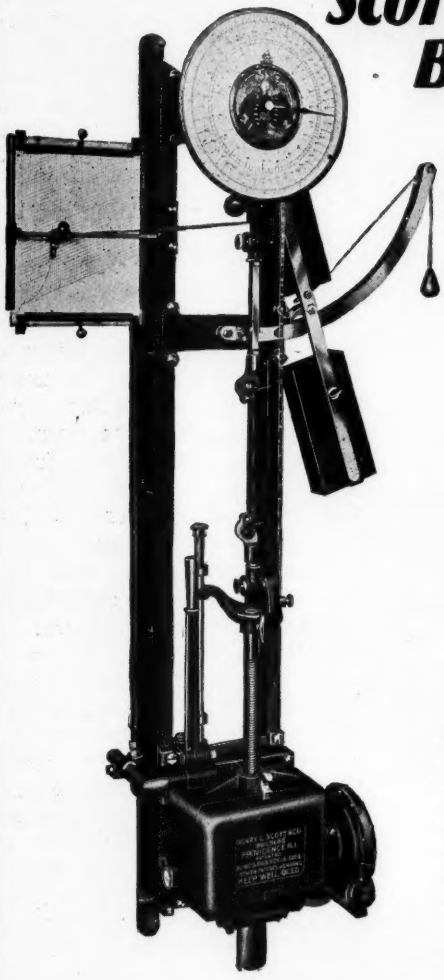
From Roads and Streets, July 1927, pp. 325-326, giving specifications of Illinois, Florida and Ohio.)

Illinois (Specification 18D) states that wire guard shall consist of a wire link fabric, ... manufactured from standard galvanized steel wire of No. 6 Washburn and Moen gage, woven in a mesh 2 in. square. One coat of white paint. Width 24 in. Top and bottom edges of fabric shall have wire turned over or knuckled. To be furnished in continuous rolls of 100 ft. wrapped in burlap. Fabric shall be attached to the side of posts, using three 1½ in. galvanized staples. On curves of galvanized metal, 6 in. wide, of 24 gage shall be securely wired to top and bottom of fabric. These shall be given two coats of white paint. After erection scratched or damaged paint on the fabric shall have an additional coat of white paint. To

(*Please turn to page 60*)

SCOTT TESTERS

SCOTT TEST FIGURES PROTECT BOTH BUYER & SELLER



The use of Automatic Record is optional—visable reading may be taken direct from dial.

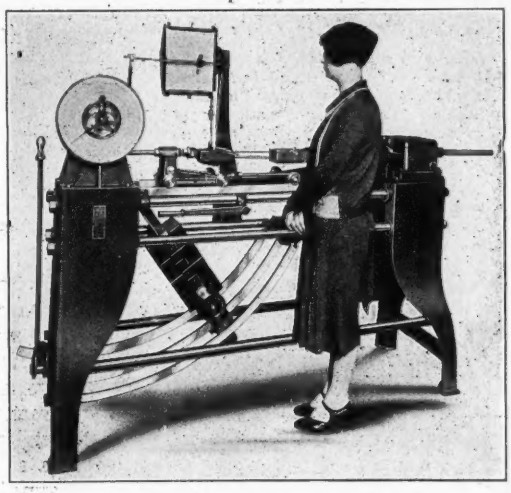
Wire diameters are NOT strength standards

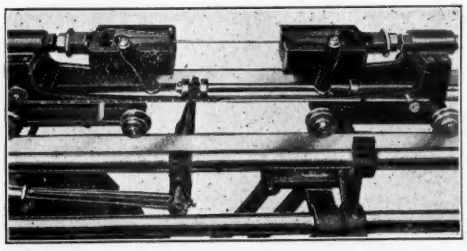
Scott Testers give accurate readings—permanent records of strength, elasticity, elongation and action under stress. These readings enable you to establish fixed standards as a basis both of purchase and use. Every Scott Tester is built for service—accurate, rugged, easy to operate and free from delicate adjustments and complications.

Illustration at the left shows Scott Wire and Metal tester—vertical type with maximum capacity of 500 pounds.

HORIZONTAL & VERTICAL TESTERS

This type of tester is applicable to a wide range of work and is considered by many to be the most convenient for general use. Belt or motor driven—high or low speed, gearing as may be required.

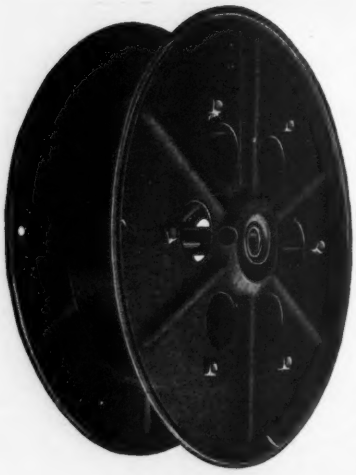




These machines with different types of clamp may be used on a great range of materials—such as Wire, Chain, Sheet Metals, Tire Fabrics, Ducks, Webbing, Cordage, Rubber, etc. to determine both tensile strength and elasticity.

HENRY L. SCOTT CO., PROVIDENCE, R. I.

SCOTT TESTERS STANDARD OF THE WORLD



American
Pressed Steel Reels
for strength, easy handling, service and long life

PRESSED steel is rapidly replacing other materials wherever both strength and lightness are desirable. This is the reason for the very general adoption of pressed steel reels and spools by large industries.

"American" Pressed Steel Reels and Spools are designed and shaped to impart maximum strength for their weight. They also embody special patented features that contribute to their rigidity and capacity for hard service.

Above is shown a 24" x 16" x 6" "American" Reel with beaded flange for shop use and shipping. Standard models range from small spools with 2½" diameter to giant reels 8' in diameter, and include Stranding, Vulcanizing, Impregnating, Braiding, Annealing, Shipping and Shop Reels and Spools and Beams for a great variety of industrial purposes.

Write for descriptive catalog explaining advantages of the "American" design and construction principles.

The American Pulley Company
Manufacturers of Steel Split Transmission Pulleys, Pressed Steel Shaft Hangers, Pressed Steel Hand Trucks and Pressed Steel Shapes
4200 Wissahickon Ave., Philadelphia, Pa.

AMERICAN
PRESSED STEEL
REELS

Wire Guard Rail

(*Continued from page 58*)

be paid for by lineal foot.

Florida specifies the same except that the fabric must be galvanized after weaving, and painted white. Fabric to be crated. Fabric shall be made of a good grade of basic open-hearth steel wire. The zinc coating shall be pure virgin spelter conforming to Amer. Soc. Test. Mtls. Spec. B 6. Fabric shall be galvanized after weaving and the weight of the coating shall be not less than 0.8 oz. per square foot and shall withstand a minimum of four 1-min. dips by the Preece tests. Quality of galvanization shall be such that zinc coating shall not crack, peel or flake during ordinary handling in shipment or erection. Zinc coating shall be tested for quantity by the stripping test and uniformity by Preece test.

Ohio specifies the same except that galvanization is at a minimum of 120 lbs. per ton (of wire). All surfaces not galvanized shall have three coats of white lead and linseed oil paint. All iron and steel shall be galvanized after fabrication.

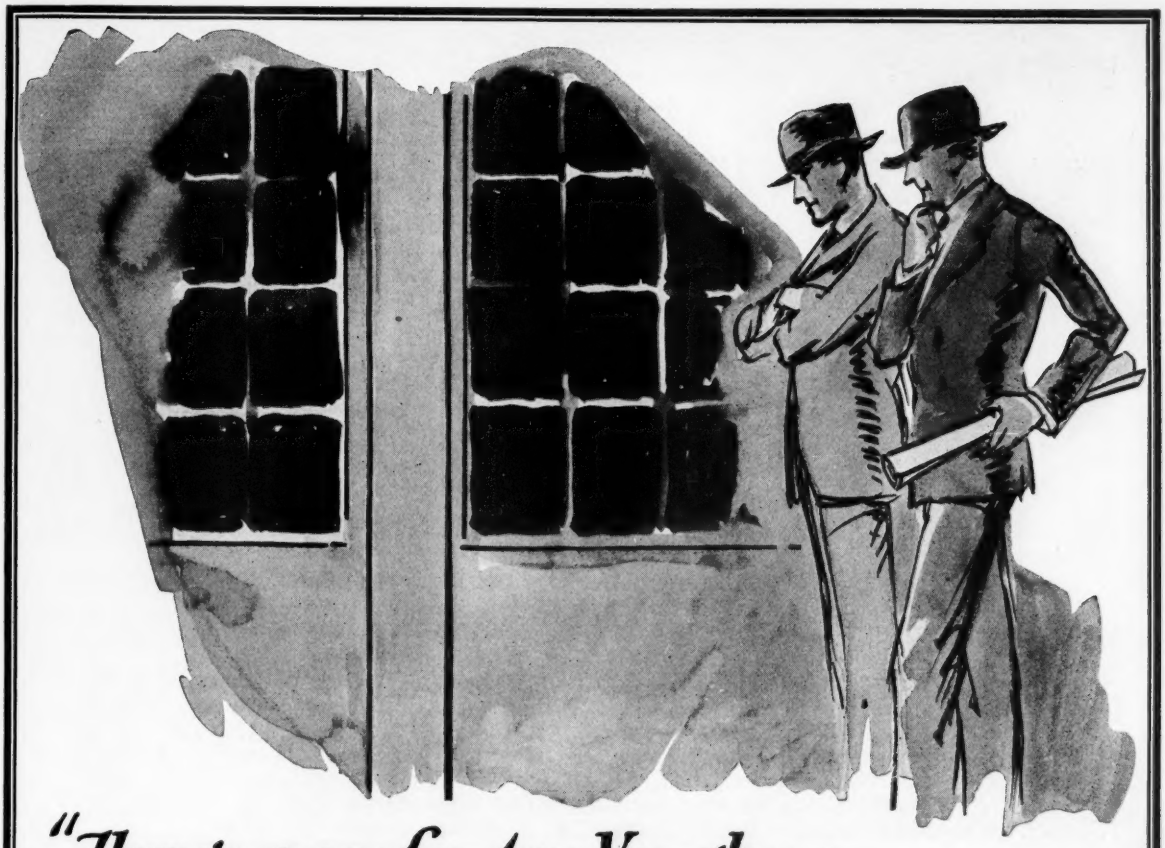
European Wire Makers Seek To Insure Profits

From article by Vincent Delport, Iron Trade Review, July 14. 1927, pp. 74.

The international rod syndicate formed to adapt the total production of wire rod to domestic and export needs fixes prices so that a normal margin exists between wire rod and wire products, enabling the profitable production of wire products. Participants include Deutsche Drahtwalzwerke (the German syndicate), Socobelge (the Belgian syndicate) and La Providence (the Luxemburg, French and Saar Syndicate. It controls the production of round and square wire rod, soft and extra soft basic Bessemer and open-hearth, from 4.75 to 13 mm. (3/16 to ½"). Effective until Dec. 31, 1931. Members will not export into protected territory of other member-countries. No reductions or discounts are to be made from the syndicate prices. Present output is set at Germany 1,125,000 metric tons a year or 57.2%; France 457,000 tons or 23.3%; Belgium 263,000 tons or 13.37%, and Luxemburg 122,000 tons or 6.20%. On the fifteenth of the second month of each quarter a provisional tonnage for each member country is fixed for the following quarter. Total is determined and each country alloted its share, also proportions for home and for export, based on sales of the preceding four quarters and considering conditions. Sales are checked at the end of each quarter and a member not reaching its alloted tonnage is entitled to compensation, either transferring other members' excess or by increasing its quantity for the next quarter. The managing committee is empowered to restrain members exceeding quotas from the export markets and to authorize backward ones to increase their export sales.

Export prices are fixed by committee, domestic by domestic comptoirs. The committee includes one member from each country. At the end of the agreement members exceeding their quotas must pay 5 shillings ($1.20) per ton into a common fund, also penalties up to £210 sh. ($14) a ton. It may be terminated by dissolution or by nonrenewal of the international entente. If the output exceeds 32,000 tons German group, 10,000 Belgian-Luxemburg, and 16,000 French-saar group, if in two consecutive periods of three-months each, the output of a member is 15% below its quota, it is permissable to transfer tonnage to it. If in a further period of six months, the situation has not improved, the members can denounce the agreement.

This seems to represent a reasonable and ambitious attempt to agree on output and prices over a period of some 5 years, with compensations as it goes along for variations among the producers themselves, as well as for change in world conditions.



"There's space for two Vaughns where the old-style machine stood!"

(A Conversation Based on Facts)

No. 2 or Intermediate Machine for drawing No. 19 to 30 Copper Wire.

"That's great," said the production superintendent to the plant engineer. "That space economy means we can double not only our wire production but also eliminate the expense and maintenance of that troublesome overhead shafting and belting."

"And that isn't the half of it, Jim," said the engineer, "you've overlooked the fact that a single one of these Vaughn Copper Wire Drawing Machines **doubles the production of each one of the old equipment it replaces.**"

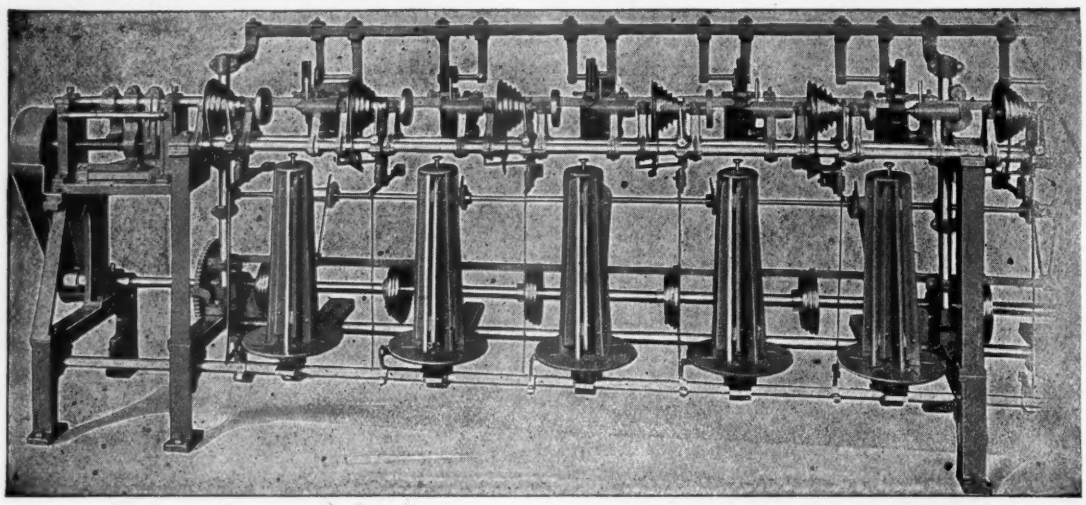
"From the No. 2 size we are planning to install—we will be able to draw 19 to 30 Copper Wire and I think we should also investigate the Vaughn No. 1 and No. 3 sizes and do a real replacing job for all of our continuous work from No. 8 down."

THE VAUGHN MACHINERY COMPANY
CUYAHOGA FALLS · OHIO

Manufacturers of Vaughn MOTOBLOCS,
Continuous Copper Wire Drawing Machines and other wire mill equipment for pointing, cleaning, baking, patenting and heat-treating, galvanizing and tinning, etc.

VAUGHN Copper Wire Drawing Machines

A complete line of Copper Wire Drawing Machines for continuous drawing, manufactured under a license from the Western Electric Company, Inc., by which certain exclusive rights have been acquired.



KOEGEL FINE WIRE SPOOLING MACHINE FOR SPOOLS UP TO 6" DIAMETER, STANDARD MACHINE FROM FOUR TO TWELVE HEADS. CAN FURNISH WITH ANY DESIRED NUMBER OF HEADS.

Above illustration shows our improved type of fine wire spooling machine. This machine has some very important features, for example, the head sections are so designed that no spool spindles are required, and this, we believe, is a very good time saver which all manufacturers will appreciate. Another feature is that the swifts or blades are located underneath the machine, and directly in front of the operator, thereby making it very convenient for the operator when filling the swifts or blades with bundles of wire. Write us for further details about this machine.

Wire Spooling and Winding Machines of Every Description

CHAS. KOEGEL'S SONS, INC.

Holyoke, Mass.

British Electric Cable Industry in 1927.

THE past year was a generally satisfactory one for the British electrical wire and cable industries that are centered in Derby and the surrounding district. Small electrical wires, bell wires, and flexes met with a consistently strong demand throughout the year. Most mills operated full time during the whole of 1927 and in many much overtime was worked. Heavy and armored cables have also been satisfactory in all classes, and many colonial contracts were received. Radio equipment, of course, played a substantial part in the boom in the electrical wire trades.

Millinery wires also experienced a fairly good year, the stock sizes in blacks and whites predominating as usual. Shipping was fairly good during the year, especially the colonial trade.

Wire & Wire Products Directory, Index and Buyers' Guide

1928 Edition

Price $5.00

Wire & Wire Products
471 Fourth Ave., New York

Appeal Against Ropeway Dismissed

(*Continued from page 46*)

port was for sale, and marketing was not "working."

In the Lord Justice's opinion, the construction the railway sought to put on the statute was too narrow. Parliament intended it was in the national interest that coal should be available for national purposes, and where the operation of rendering the coal available was hampered by the refusal of persons whose consent before the Act was necessary to grant proper facilities for the process of making the coal available, the Commission might override that refusal

on terms which it considered proper. It was said that this construction might lead to the construction of hundreds of miles of railroad without any of the precautions ordinarily taken by Parliament to protect private interests. In the view of the Court, however, Parliament has placed confidence in the Commission, both to protect private interests and to override them if it is in the interests of the nation to do so.

Lord Justice Sargant and Lord Justice Greer delivered judgments agreeing that the appeal should be dismissed.

Rope Combine Makes Bad Start

(*Continued from page 57*)

the combine is now in a better position to take the fullest advantage of any improvement which may occur in the general trade position.

The report contains the following statement showing the company's assets, together with those of its subsidiaries at August 31, 1927, before providing for income-tax or depreciation in respect of the year to that date:

Goodwill	£487,727
Land, buildings, plant, machinery, etc.	2,713,112
Stocks on hand	855,964
Bills receivable, sundry debtors and debit balances	754,973
Investments in associated companies, etc.	208,602
Cash at bankers and in hand	209,750
Preliminary expenses and costs of note issue (less amount written off, £50,000)	96,975
	£5,327,103

The profit and loss account shows that dividends from subsidiary and associated companies amounted to £33,195, and a balance brought forward from August 31, 1926, of £21,999. After payment of interest on the note issue and the dividend on the Preference shares to December 31, 1926, there remains a balance of £9,735 ($48,675).

Lower costs—
better quality

A WIRE manufacturer who has been cleaning with Oakite materials for over two years, traces a substantial reduction in pickling costs and marked improvement in quality to his cleaning operation.

Previously, trouble had been met in getting a good pickle. But by dipping the wire into an Oakite solution before pickling, a coating of drawing soap which formerly retarded the action of the acid is thoroughly removed, and a 30 second pickle now gives excellent results. The subsequent operation, tinning, is improved, and a better finished wire is obtained.

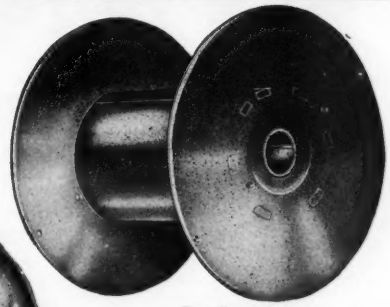
Write us regarding any cleaning problem that may confront you. No obligation.

Oakite Service Men, cleaning specialists, are located in all the leading industrial centers of the United States and Canada

Oakite is manufactured only by
OAKITE PRODUCTS, INC., 52A Thames St., NEW YORK, N. Y.

OAKITE
TRADE MARK REG. U.S. PAT. OFF.
Industrial Cleaning Materials and Methods

Specializing in the Manufacturing of REELS & SPOOLS of all sizes.



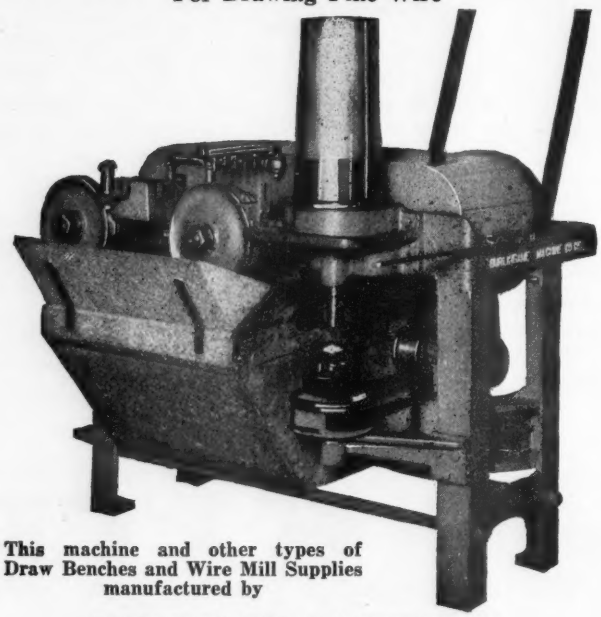
For Annealing and Handling Fine Wire

Spool for Handling and Shipping Wire. (Patented)

We solicit your inquiries

Mossberg Pressed Steel Corporation
81 WEST ST., ATTLEBORO, MASS.
Russell A. Singleton Co., 2016 Cockrell Ave., DALLAS, TEX.
140 S. Dearborn St., CHICAGO, ILL.
Southern Office, 33 Norwood Place, GREENVILLE, S. C.

Continuous Wire Drawing Machine
6 Draft Liquor Finish
For Drawing Fine Wire



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100 FIFTH AVE., NEW YORK CITY

Electroplating

(Continued from page 52)

having wires on both sides of the anodes suspended from them. Under this arrangement it is not possible for one wire to have a heavier plate than another and even the tendency of the tank to have uneven agitation can be offset by the anode shifting above described for if the anodes are shifted about until each bus bar has the proper amperage it will be found that the areas of high tank agitation will have few anodes while the areas otherwise causing trouble on account of insufficient agitation will have more anodes. If a tank set-up is found to operate without amperage fluctuations in the bus bar ammeters it is immaterial if there are twice as many anodes surrounding one wire as surround the next.

Because of the small cathode surface in wire plating compared to the anode surface exposed it becomes necessary in wire plating to add silver to the bath from time to time in addition to that dissolved from the anodes as the condition for perfect anode-cathode balance is not here present. This is best done by the addition of silver double cyanide the salt being easily prepared from the anode butts. The standard procedure as given by the plating hand books is easily followed and is much more economical than the purchase of silver cyanide.

It is strongly recommended that all plating tanks for wire plating by the cyanide process be installed so that the bottom of the tank is about a foot and a half above the floor level. This will facilitate the change of the tank solution when the concentration of the end products of the reaction together with the absorption of atmospheric carbon dioxide make it advisable to renew the plating bath.

When this is necessary the plating solution may be run into a storage tank by gravity and the silver recovered by the simple expedient of plating it out upon anodes used here as cathodes, the anodes in this case being insoluble such as carbon plates.

Materials of Construction

The equipment described for continuous electroplating of wire must for the most part be constructed by the plant using it as there are no plating equipment supply companies in a position to manufacture this equipment at the present time. The difference in behavior between the ordinary plating set-up and the set-up for wire plating has made it impossible for the plating supply companies to give operating data on the subject and heretofore owing to the numerous unsuccessful attempts to plate wire the plating houses have been loath to advise as to possible methods. The generators and tanks may be bought from these houses as well as all the plating solutions but the system of rolls and the spooling device must be designed by the user.

The tanks may all be standard plating tanks of wood excepting the hot caustic tank which must be of iron and those washing tanks holding hot water should also be of metal. The best wood tank lining is known in the trade as Blown Oil. A very thin coating will suffice and it is supplied by the tank makers and applied by them before tanks are shipped.

The submerged rolls may be of wood such as cypress or better of porcelain or glass. The rolls guiding the wire into the plating tank as well as the rolls guiding it as it emerges from the plating tank must be of metal as they are used to lead the current from the wire to the cathode side of the generator. Brush arrangement on the hubs of these metal wheels to insure constant current flow is better than depending upon a metal axle through the wheel as the latter tends to cause the current to fluctuate.

The wire spooling device where only one wire is being plated may be a small block but in the case of multiple wire plating a specially designed spooling device is necessary. This will be described in detail in a subsequent article to appear in these pages at an early date.

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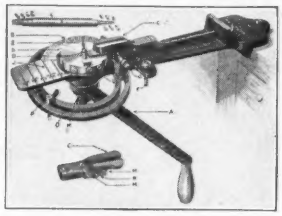

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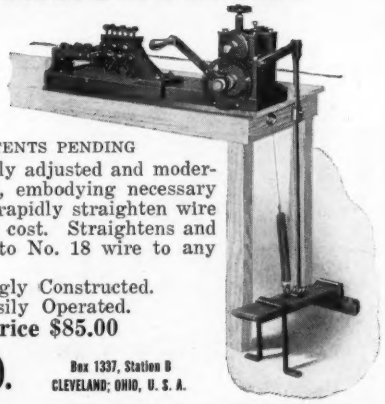

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Effect of Drawing and Blueing

(*Continued from page 49*)

with what is known as 'hard spelter', which is a dross containing 3 to 4% iron, and which settles at the bottom of a galvanising bath.

A microscopical study of the structure of material before galvanising, shows that where there is large grained and easily penetrated material the zinc runs into the steel in little rivers, and it depends upon the extent of this layer whether the wire will lose its power to bend and twist or not taken in conjunction with the change due to the heat-treatment which the wire receives in passing through the molten zinc.

In mild steels it has been shown that the elasticity is changed with temperatures as low as 200° C. Hard steel wire, if left in the bath for any length of time, would, of course, become softer, but the gain will be offset by the formation of a heavier layer of iron-zinc alloy. N. B. It is, therefore, very important when galvanising wire that all damage due to the pickling process should be removed, that the proper bath temperature of the zinc be taken, and also that the time the wire is in the bath should be carefully controlled. As regards the temperature of the zinc bath, this has to be round about 470° C.

Professor Haigh has shown that high tensile hard drawn steel wires, when galvanised, are liable to suffer as regards the fatigue limit. Temperatures below the recalescence point tend to the re-crystallisation of ferrite in larger grains, and at these temperatures pearlite tends to re-dissolve itself from the sorbitic to the filmy, spotted, and eventually, to the spheroidal state.

Although pearlite is only very slowly dissolved in normalised steels, it is much more rapidly decomposed in hardened and drawn steel. This, no doubt, is because amorphous ferrite is present in abundance, and the

action probably begins at about 300° C. and increases in rapidity with the rise of temperature,—particularly round about 500° C. —on account of the increasing mobility of the amorphous metal. This change reduces the tensile strength of the wire, and also reduces the useful work that the wire will do,—that is to say, reduces the fatigue limit. It is, therefore, very unwise to heat hard drawn steel wire above 500° C. excepting where additional ductility is required at the expense of tensile strength.

Iron-zinc alloys, unfortunately, are not simple solutions; zinc melts at 417° C. and one can dissolve iron up to about 0.8%, forming a satisfactory alloy of ductile character, well adapted for a protective coating, and this is the alloy that should be produced in galvanising. Longer immersion in the molten zinc at temperatures above 422° C. or short immersion at a higher temperature, produces an iron alloy with large crystals containing as much as 6.5% iron; these crystals are very brittle, and are very liable to contain fissures which are harmful.

These large crystals of iron-zinc are formed more rapidly from cold worked steel than from steel that has been hardened and tempered to the tensile strength required, therefore the immersion of hard drawn steel wire should be less than that permissible for hardened and tempered material. The iron crystals form more rapidly when the zinc bath contains iron in solution; it is, therefore, necessary to see that the zinc bath is kept reasonably free from dross or hard spelter.

Apart altogether, however, from any of the above due to the zinc coating itself, there is undoubtedly a deleterious effect due to the mere heating of hard drawn wire. This has been found in other operations than hot-galvanising. Tinning has a slight but similar effect, and researches on the heat-treatment of wire after drawing have shown that:

Any form of heat-treatment after cold work below the recrystallising temperature —

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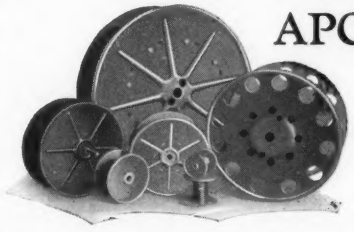

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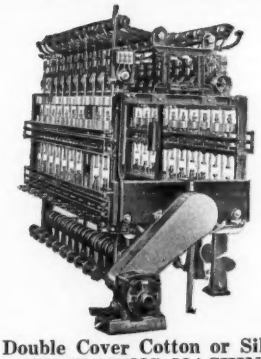

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Domestic Exports of Iron and Steel Wire, Wire Rope and Nails, From the United States, By Countries

November 1927

Countries	Plain iron or steel wire	Galvanized wire	Barbed wire	Wire rope	Insulated iron or steel wire and cable	Wire nails
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Denmark & Fr. Is.	.....	.....	.....	.....	310	.....
France	25,721	.....	.....	.....	.....	.....
Germany	11,030	.....	.....	.....	.....	.....
Greece	.....	.....	.....	1,312	.....	.....
Norway	7,300	.....	.....	.....	.....	45
Portugal	1,653	.....	.....	.....	.....	.....
S. Russia in Europe	.....	.....	.....	.....	.....	6,000
Spain	660	.....	.....	1,600	.....	.....
Sweden	700	.....	.....	.....	.....	.....
United Kingdom	72,984	49,297	15,873	48	1,242	40,880
Canada	509,366	2,312,056	297,475	179,555	2,818	9,620
B. Honduras	.....	134	10,950	330	.....	196
Costa Rica	2,704	2,422	36,000	968	.....	4,394
Guatemala	.....	.....	69,720	620	.....	7,540
Honduras	.....	183	174,900	6,421	132	34,419
Nicaragua	.....	525	286,880	1,598	.....	51,718
Panama	1,427	4,000	23,010	30,011	.....	129,579
Salvador	3,500	150	.....	.....	1,710	10,100
Mexico	138,351	152,278	766,253	73,298	5,580	138,527
Miquelon & St. Pierre Is.	.....	.....	.....	.....	.....	20,000
Newfoundland & Labrador	550	45,252	.....	550	.....	500
Bermuda	.....	187	.....	560	.....	2,640
Jamaica	.....	623	21,420	1,368	548	1,000
Trinidad & Tobago	.....	.....	1,500	24,238	.....	7,700
Other B. W. Indies	.....	750	4,200	6,613	3,180	5,244
Cuba	28,006	78,851	995,848	67,987	47,254	482,492
Dominican Rep.	13,524	43,150	188,040	1,792	1,482	41,048
Neth. West Ind.	500	.....	2,011	2,338	.....	1,150
Haitian Republic	1,909	654	.....	710	.....	14,450
Virgin Is. of U. S.	.....	1,900	8,000	522	.....	6,200
Argentina	645,351	1,736,120	1,486,275	202,211	210	2,371
Bolivia	.....	.....	5,252	2,846	161	1,200
Brazil	79,456	1,010	2,437,011	2,688	7,154	3,213
Chile	2,636	12,840	55,115	15,118	2,264	37,800
Colombia	90,087	25,657	435,040	15,576	2,718	324,804
Ecuador	7,940	2,000	37,032	.....	.....	320
B. Guiana	.....	2,000	.....	290	.....	.....
Paraguay	.....	.....	174,100	.....	.....	60,000
Peru	457,247	28,163	48,500	147,615	1,082	197,200
Uruguay	51,201	66,689	187,328	280	283	.....
Venezuela	1,576	24,318	.....	28,700	4,532	36,049
B. India	.....	.....	71,736	1,020	.....	720
B. Malaya	.....	.....	63,000	.....	.....	400
China	97,700	190,590	.....	.....	.....	135,000
Java & Madura	.....	.....	51,808	75,346	.....	60,055
Other Neth. East Ind.	.....	.....	195,770	40,420	240	.....
Hongkong	.....	190,040	.....	.....	.....	.....
Japan, inc. Chosen	171,858	36,818	.....	7,708	.....	.....
Persia	.....	.....	.....	3,775	.....	.....
Philippine Is.	140,751	6,450	588,325	109,165	.....	555,363
Australia	154,414	49,392	11,200	5,795	.....	11,422
B. Oceania	.....	.....	14,672	.....	.....	3,688
F. Oceania	100	.....	.....	.....	.....	1,400
N. Zealand	53,649	35,840	.....	2,907	.....	300
B. E. Africa	.....	.....	.....	529	.....	.....
B. S. Africa	4,773	.....	337,680	9,910	.....	248
Morocco	.....	.....	.....	390	390	.....
Total Quant.	**2,788,624**	**5,100,339**	**9,101,924**	**1,074,728**	**83,290**	**2,446,048**
Total Values	**110,313**	**138,405**	**269,045**	**136,203**	**10,589**	**77,889**

Shipments from the United States to Non-Contiguous Territories.

	6083 Wire		6092 Wire Nails	
	Pounds	Dollars	Pounds	Dollars
Alaska	25,160	3,063	94,818	4,394
Hawaii	287,391	28,583	148,330	7,152
Porto Rico	235,810	15,719	135,307	4,415

which lies between 500° C. and 600° C. according to the class of steel—has, on the whole, a deleterious effect on the physical properties.

Although the elasticity and the percentage elongation are tests increased by such treatment, the bend and torsion tests show that the steel is in a brittle condition.

Time plays a very important part in this treatment, and such operations as hot-galvanising and tinning should be conducted as quickly as possible, so that the effects of heating are reduced to a minimum.

Domestic Exports of Iron and Steel Wire Manufactures, Horseshoe Nails and Horseshoes From the United States, By Countries

November 1927

Countries	Woven wire fencing	Wire cloth & screening		Wire n. e. s. & manufactures of	Horseshoe nails	Horseshoes
	Pounds	Pounds	Dollars	Pounds	Pounds	Pounds
Belgium	.....	.....	.....	1,310	2,420	.....
Denmark & Fr. Is	.....	.....	.....	1,051	.....	.....
Finland	.....	.....	.....	101	.....	.....
France	.....	.....	.....	2,806	.....	.....
Germany	.....	.....	.....	255	508	.....
Greece	.....	.....	.....	1,402	.....	.....
Hungary	.....	.....	.....	195	.....	.....
Italy	.....	.....	.....	107	.....	.....
Netherlands	66,572	.....	.....	128	7,286	.....
Norway	.....	186	21	728	.....	413
Portugal	.....	.....	.....	55	.....	.....
Spain	9,924	.....	.....	2,503	.....	.....
Sweden	.....	.....	.....	1,554	.....	.....
Switzerland	.....	.....	.....	.....	5,178	.....
Turkey in E.	.....	.....	.....	776	.....	.....
United Kingdom	92,666	821	50	103,965	.....	.....
Canada	192,206	98,708	33,892	696,175	.....	23,523
B. Honduras	.....	177	33	71	.....	400
Costa Rica	1,451	3,889	513	917	1,320	5,000
Guatemala	538	664	86	2,284	.....	200
Honduras	4,467	3,847	446	367	.....	813
Nicaragua	1,042	2,656	371	2,813	.....	.....
Panama	16,427	13,857	822	21,532	614	.....
Mexico	33,631	29,994	6,175	81,416	72,463	11,700
Miquelon & St. Pierre Is.	.....	.....	.....	47	.....	.....
Newfoundland & Labrador	.....	.....	.....	35,758	1,625	.....
Bermuda	80	1,093	118	830	.....	.....
Barbados	.....	.....	.....	1,200	.....	.....
Jamaica	6,214	1,231	209	1,805	50	.....
Trinidad & Tobaga	14,536	3,091	376	197	.....	.....
Other B. W. Indies	.....	277	28	410	.....	100
Cuba	117,531	9,938	1,272	44,027	23,085	2,800
Dominican Rep.	3,934	8,985	1,146	5,700	.....	800
Neth. West Ind.	21,294	.....	.....	910	.....	.....
Haitian Rep.	7,184	479	109	634	150	.....
Virgin Is. of U. S.	.....	335	92	68	.....	.....
Argentina	.....	14,085	2,575	34,255	300	.....
Bolivia	.....	439	205	2,342	.....	.....
Brazil	.....	6,133	433	9,431	550	.....
Chile	4,947	761	228	3,852	2,050	5,000
Colombia	51,739	18,985	2,796	6,582	37,085	.....
Ecuador	.....	486	86	2,493	7,640	.....
B. Guiana	.....	150	35	197	.....	.....
Surinam	.....	1,527	170	.....	.....	.....
Paraguay	2,136	.....	.....	327	.....	.....
Peru	.....	10,919	1,185	9,752	.....	.....
Uruguay	.....	180	28	150	.....	.....
Venezuela	4,857	3,145	483	5,561	5,579	.....
Arabia & Hejaz	12,800	.....	.....	.....	.....	.....
B. India	2,600	6,109	1,222	5,152	2,240	.....
B. Malaya	.....	.....	.....	920	.....	.....
Ceylon	.....	.....	.....	1,650	.....	.....
China	242	5,496	2,367	8,410	6,020	.....
Java & Madura	25,703	672	202	2,572	.....	.....
Other Neth. East Indies	1,196	.....	.....	.....	.....	.....
Japan, inc. Chosen	.....	.....	.....	24,663	26,000	.....
Palestine	.....	.....	.....	.....	10,000	.....
Kwantung leased Ter.	.....	.....	.....	5,733	.....	.....
Philippine Is.	105,886	18,236	2,430	62,282	.....	36,000
Syria	.....	.....	.....	1,104	.....	.....
Australia	.....	25,659	4,796	150,464	7,659	.....
B. Oceania	.....	50	18	.....	.....	.....
F. Oceania	.....	225	30	.....	50	.....
N. Zealand	.....	564	106	5,852	1,800	.....
B. S. Africa	.....	25,445	6,744	5,967	.....	.....
B. W. Africa	.....	.....	.....	335	.....	.....
Egypt	.....	.....	.....	5,960	.....	.....
Algeria & Tunisia	116	.....	.....	.....	.....	.....
Liberia	.....	.....	.....	448	.....	.....
Mozambique	.....	8,192	1,338	1,182	.....	.....
Total Quant.	**801,919**	**327,686**	.....	**1,371,733**	**221,672**	**86,749**
Total Values	**45,603**	.....	**73,236**	**149,661**	**24,695**	**6,406**

The structural effects of heat-treatment after cold work are scarcely visible until re-crystallisation commences. When this occurs the ferrite forms new grain boundaries, and the cementite collects in the form of nodules, which tend to coalesce.

This structure is typical in steels which have been heated below the critical range after cold work. It constitutes a complete separation of the constituents of pearlite and sorbite.

Photographs are shown of wire that has been properly galvanised, and wire that has been in the bath too long at too high a temperature.

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DIAMOND TOOLS

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(U. S. Patent 1,624,027. April 12, 1927.)
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M. D. Kilmer & Co., Cleveland, Ohio.

MACHINERY—Gem Clip
J. I. Bernitz, New York.
M. A. Irmischer

MACHINERY—Insulating
American Insulating Machinery Co., Philadelphia, Pa.

MACHINERY—Nail
J. I. Bernitz, New York.
M. A. Irmischer, New York.
Sleeper & Hartley, Inc., Worcester, Mass.

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M. A. Irmischer, New York.
Morgan Construction Co., Worcester, Mass.
Standard Machine Works, Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

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Sleeper & Hartley, Inc., Worcester, Mass.

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M. A. Irmischer, New York.
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Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson.

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MACHINERY—Panning
American Insulating Machinery Co., Philadelphia, Pa.

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Sleeper & Hartley, Inc., Worcester, Mass.

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Broden Const. Co., Cleveland, Ohio.
Burlingame Machine Co.
Kratos Wks., N. Y. C.
Morgan Construction Co., Worcester, Mass.
M. A. Irmischer, New York.
Sleeper & Hartley, Inc., Worcester, Mass.
Superior Tool & Mfg. Co., Worcester, Mass.
The Vaughn Machinery Co., Cuyahoga Falls, Ohio.

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Oakite Products, Inc., N. Y.

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Apco-Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

PRESSES—Rivet & Bolt
M. A. Irmischer, New York.

SOAPS—Wire Drawing
R. H. Miller Co., Homer, N. Y.

SPOOLS—Wire & Cable
American Pulley Co., Philadelphia, Pa.
Apco-Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

TRUCKS
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

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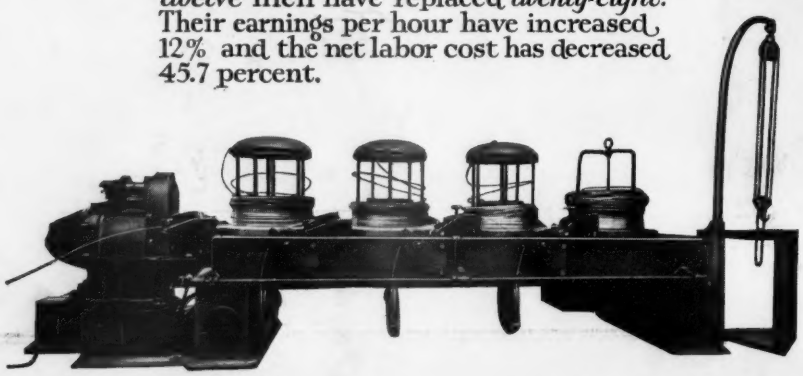

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